PC MAGAZINE

VOLUME 8 NUMBER 6
MARCH 28, 1989

Penny-Pinching LANs

First Looks:
- Intel's Visual Edge Delivers Real Halftones
- *Mathematica* for the PC Arrives
- *Paradox* 3.0 Guns for *dBASE*

PC Labs Tests 21 Desktop Scanners
- Great Gray Scales
- Accurate OCR
- Smarter Software

Excel Tips: 25 Ways
To Make the World's
Best Spreadsheet
Better

**PC LAN Labs Tests
11 Serious LANs**

$350 per User

Full-Featured

Install-It-Yourself

This is abou

At this moment, millions of Lotus® 1-2-3® users are faithfully awaiting the arrival of a product called Release 3. A character-based product that promises greater power and greater productivity for serious spreadsheet users.

As soon as it gets here.

In the meantime, we have a question: If Release 3 is in fact character-based, and the entire personal computing industry continues moving toward *graphics*-based environments, is it wise to wait for Release 3? Or consider the alternative.

Microsoft Excel. Or, how to see Lotus 1-2-3 Release 3 from a whole new perspective.
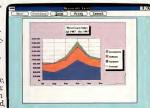
Actually, you can do both. Because you have nothing to lose by seeing the other side of the spreadsheet story, and trying it for yourself.

It's called Microsoft® Excel. The spreadsheet specifically designed for graphic environments—the industry's emerging standard. Five minutes in front of a demo will show you the fastest,

Unfortunately, 1-2-3 won't let you move, size, and link an unlimited number of files at the same time. Fortunately, Microsoft Excel will.

easiest, most enjoyable way to crunch your numbers. Thanks to an incredibly intuitive design that exploits innovations like Micro-

As you know, with 1-2-3 your ability to customize worksheets and charts is limited. As you may not know, with Microsoft Excel the possibilities are limitless.

soft Windows, OS/2 Presentation Manager and, of course, the Macintosh.®

You're a loyal Lotus user. If you're a bit skeptical, we fully understand that. We also anticipated it. So we've made sure your hard-earned equity in 1-2-3 is not

obsolete. In fact, we've not only made a transition to Microsoft Excel attractive, we've also made it easy: Microsoft Excel actually reads and writes

Unbelievable CPU Prices.

386SX
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- 80386SX CPU running at 16MHz
- Zero wait state, Norton V.3 SI rating: 18.7
- 1 MB memory (expandable to 8 MB using SIMM on board)
- 384K shadow RAM
- 1.2 MB floppy disk drive
- Dual floppy/hard disk controller
- Ports: 2 serial, 1 parallel, 1 game
- Clock/calendar with battery backup
- 101-key enhanced keyboard
- Award BIOS
- 80387SX math co-processor socket
- 8 expansion slots

286/20
$1,295

- 80286 CPU running at 20MHz
- Zero wait state, Norton V.3 SI rating: 23
- 512K memory (expandable to 4 MB using 1 MB DRAM on board)
- 384K shadow RAM feature
- 1.2 MB floppy disk drive
- Dual floppy/hard disk controller
- Ports: 2 serial, 1 parallel, 1 game
- Clock/calendar with battery backup
- 101-key enhanced keyboard
- Phoenix BIOS
- 80287 math co-processor socket
- 8 expansion slots

286/12
$995

- 80286-12 CPU running at 12MHz
- Zero wait state, Norton V.3 SI rating: 15.3
- 512K memory (expandable to 4 MB using SIMP on board)
- 1.2 MB floppy disk drive
- Dual floppy/hard disk controller
- Ports: 2 serial, 1 parallel, 1 game
- Clock/calendar with 10 year battery life
- 101-key enhanced keyboard
- Phoenix/Award BIOS
- 80287 math co-processor socket
- 8 expansion slots

SOLUTIONS

WHAT'S INSIDE

PC Magazine readers lead busy lives and don't want their time wasted by stories that aren't hands-on product reviews or productivity-enhancing tips. Every rule has its exception, however, and within *PC Magazine*, it's Communiqués, the humor page that tracks the industry's glitches and foibles.

Communiqués is researched by a wide area network of 700,000 people—*PC Magazine* readers who scour magazines, newspapers, and ads for typos and awkward facts. Nearly 1,000 submissions pour in monthly, citing classified ads for Bleeding Edge PCs and cereal printers and job openings for candidates familiar with IBM's Tolkien Ring network.

Key to the evolution of Communiqués' style has been executive editor Bill Howard, who gave a firsthand demonstration of his well-honed wit at *PC Magazine*'s annual market for Technical Excellence late last fall in Las Vegas as he presented the award for best portable computer. Howard strolled onstage dragging a 30-pound first-generation Compaq portable atop a child's red wagon and observed that "early users were easy to spot—one arm was longer than the other." His comparison of the new generation of portables to then President- and Vice President-elect George Bush and Dan Quayle ("One offers substantially improved memory; the other is incredibly light-weight") brought down the house.

Howard's all-time favorite Communiqué: a 1987 help-wanted ad in a Texas newspaper seeking a Wang- and IBM-literate accountant "with a strong sex background . . . you'll be tested by our CPA sex specialist." The word *tax* was inadvertently replaced by *sex*. Close runner-up:

Executive editor and Communiqués author Bill Howard backstage with an early portable PC and peripheral.

Zenith's 1986 annual report, with a silver sticker hiding a back-cover misspelling of Zenith's motto "The quality goes in before the name goes on."

"Since we make fun of everyone else, we're fair game, too," Howard says. The most recent *mea culpa* recognized in Communiqués: the January 17, 1989, cover with a plaque reading "Fifth Annual Awards for Technical Excellence."

Turn to our cover story, however, and you'll find a subject that for many people is anything but funny: selecting and installing the do-it-yourself network. PC LAN Labs evaluates 11 LANs averaging $350 per workstation for a 6-user network, and workgroup systems editor Frank J. Derfler, Jr., outlines the benefits and pitfalls of the low road to productive data sharing. **—Paul B. Ross**

Cover Photography:
David Arky
Model Construction:
Bruce Morozko

From hardware to quality output takes smart scanner software. Which scanners have it? Page 187.

PC MAGAZINE

The big idea be
most adaptab

hind the world's
le PC system.

It's so simple: a building block approach that makes upgrading our new computers a snap. Literally. It's the PC design for the '80s. *And* the '90's. Because it protects your PC investment against obsolescence. Wyse calls it Modular Systems Architecture.™

It's this easy to upgrade the CPU—and boost the power—of a SystemWyse PC.

We've incorporated all computing functions—including the heart of the computer, the CPU and its microprocessor—on plug-in boards. So as your computing needs grow, you can upgrade our general purpose 8 megahertz model to a high performance 12.5 megahertz 286 machine—or even a 16 megahertz 386. When more powerful microprocessors are available, you'll even be able to boost the performance of our top-of-the-line WYSEpc 386.

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operating systems, such as MS-DOS, OS/2, and Xenix. And it's backed by the company that produces more terminals than anyone but IBM, with over one million sold.

The big idea behind SystemWyse, above all, is to adapt more readily than any other PC system to change. Because when survival belongs to the fittest, the only true survivors are those who remain fittest, longest. Please call for more information. **1-800-GET-WYSE**

The WYSEpc 386, one of the most powerful PCs in the business, with exceptional memory speed as well as processing speed.

WYSE

We make it better, or we just don't make it.

LETTERS TO PC MAGAZINE

KEEPING OPINIONS IN LINE

Get the opinions out of your technical features and keep them in the editorial columns where they belong. The latest example was Ray Duncan raising the "DOS Is Dead" vs. "DOS Forever" debate in Power Programming (PC Magazine, December 27, 1988). I can't believe your editors let a page and a half of editorializing start off a column entitled "Parsing Command Lines in OS/2."

Monte Copeland
West Palm Beach, Florida

EDITING BY COMMITTEE

If the "Editor's Choice" is a collaborative judgment (Letters, PC Magazine, December 27, 1988) that is made by all the editors involved in a review, then might I suggest changing that to "Editors' Choice" to better reflect the plural nature of this decision.

Mark L. Leavy
Baltimore, Maryland

ORGANIZING THE ORGANIZERS

Kudos to you for a gallant effort at organizing the information organizers ("Classified Intelligence: Managing Personal Information," PC Magazine, December 13, 1988). The inclusion of a fifth category, Record Management, would have provided your readers with a key additional criterion by which to judge the value of a PIM. We have found this feature to be among the most-often-mentioned reasons for choosing Info-XL.

Gary J. Jose
Valor Software
San Jose, California

Luisa Simone produced a beautiful review of Persoft's IZE ("Classified Intelligence: Managing Personal Information"), in which she expressed a wish for the program's inclusion of the "lacking" file of all the keywords assigned to a textbase. I contacted Persoft to pose a similar request and was sent a copy of a small program called Showbase that does precisely what Simone requires.

Andrew Tearle
Auckland, New Zealand

KEEPING MANES ON TREK

Stephen Manes's column made it clear that we have been working on the wrong technology, creating modems and faxes and video conferencing ("Communications ERA? Be There or Be Square!" PC Magazine, January 17, 1989). Obviously the next step is a Space Station Conference Center and "Beam me up, Scotty!"

Joan M. Lexau
Otisville, New York

POWER TODAY, GONE TOMORROW

I was one of those uncomfortable souls who was thinking that perhaps PC Magazine was moving too fast, claiming that all the technology I use is passé. Bill Machrone did a superb job of reminding me how far we've come and how much of a "radical" I could be considered ("Changing the Spec," PC Magazine, January 17, 1988).

Thanks for reminding all of us that somebody has got to be on the lookout for the new, exciting technologies that the so-called power users and "raving technomaniacs" will be using as standard equipment next year.

Michael D. Wade, Sr.
Lexington, Kentucky

LANs: DO WE NEED THE SPEED?

What's the big deal when these new superfast LANs are announced ("Building Workgroup Solutions: LAN Gateways,

Part 1," PC Magazine, November 29, 1988)? Both 10- and 16MB LANs are great, but are there peripherals and buses that will support these speeds? And if I did want to use these fast LAN speeds, wouldn't I have to upgrade to faster (and more-expensive) PCs as well?

Dennis Strtic
Lewisberry, Pennsylvania

IS YOUR PC A LEMON?

I have been a service technician for years and I find Jack D. Flanders's statement "computers being made today are so dependable that no buyer even considers reliability" to be ridiculous (Letters, PC Magazine, December 27, 1988). Reliability varies even among the "big name" manufacturers. A great deal of junk is being sold

■ LETTERS

out there, and the computer consumers should be just as careful as they are when buying any other product.

Derrick Brasslett
Manchester, New Hampshire

THE RIGHT TOOL FOR THE JOB

As I continue to read *PC Magazine*, I see a pattern of advice in which technology is the sole basis for recommendations that appear to be increasingly out of context.

In his 80286 review ("The 80286: Unsafe at Higher Speeds?" *PC Magazine*, December 27, 1988) Edward Mendelson concluded the article

with a recommendation to buy 386-based computers. 80286 technology has a place, along with all the other technologies. The crucial issue is to select the most suitable system to match a variety of factors such as application, price, and performance.

Brian P. Murphy
St. Paul, Minnesota

Rather than a PS/2 and OS/2, why not recommend any 286, DESQview, Version 2.2, and an All Chargecard ("The 80286: Unsafe at Higher Speeds?")? There is no performance penalty, all of one's present software is compatible, and the upgrade cost is minimal. This combination of hardware and software has made a dramatic impact on my equipment, eliminating any thought of upgrading to a 386 in the foreseeable future.

D. W. Beistel
Rolla, Maryland

In your review of 286 machines, a 386 machine was awarded the Editor's Choice ("The 80286: Unsafe at Higher Speeds?"). Apparently, no consideration was given to the following consideration: buy a 16-MHz 286 motherboard for about $500 to replace an 8- or 10-MHz AT-clone motherboard. Then wait for the 80386SX CPU replacement kit (approximately another $500). In addition, replace the RAM.

While the above setup will not provide the high speed of the 25-MHz 80386, it

will supply additional speed in a much cheaper context and will provide the 80386 virtual machine and memory-mapping facilities via the 386SX.

Tom Miller
Reston, Virginia

LANs ARE GOOD FOR BUSINESS

Doesn't John C. Dvorak realize that networks are good for some things ("The Agony of Networks," *PC Magazine*, December 13, 1988)? For instance, consultant convinces client to install network; consultant buys ATs, terminals, and software; consultant leaves town. Result: I have a new client for 20 percent more than my normal rate.

C'mon John, these guys are creating a great "clean up the mess" job market!

Michael Toy
Albuquerque, New Mexico

RIGHT LANGUAGE, WRONG ERA

Lahey FORTRAN? Language product of the year ("Fifth Annual Awards for Technical Excellence," *PC Magazine*, January 17, 1988)? In an era of object-oriented, windowed environments, Unix, OS/2, and the like, you give your award to a language that doesn't have the good grace to quietly die its well-deserved and long-overdue

> ■ Why give your tech excellence award to a language that doesn't have the good grace to die a long-overdue death?

death? You almost got there with Turbo ASM and Zortech C++. But FORTRAN?

Brook Monroe
Durham, North Carolina

ALL OUR REPS ARE BUSY...

I wish *PC Magazine* would test technical support as thoroughly as the software. I have found great variation in support, and price and popularity are no indication.

■ LETTERS

I recommend buying software only on a return-privilege basis. Test the support early in the evaluation. If the support is poor, return the software and get something else. Then, write to the president of the company and relate the details.

Kenneth L. Kayser
Milwaukee, Wisconsin

DVORAK IS GOOD READING

Albert E. Capito obviously knows nothing about exceptional computer journalism (Letters, *PC Magazine*, December 27, 1988). John C. Dvorak is one of the best journalists I have ever had the pleasure of reading.

Brian A. White
Wichita, Kansas

AND ON THE COVER, YET

I reely liked yore cover award fore tecknickel exalence (*PC Magazine*, January 17, 1989), an I speshally liked the way you spelt teckchnikal. Could you gues tel me the naim of yore spel-chekker, so i can yuze it in my klasses? Thanx allot.

Dean Galitsis
Assistant Principal
L.I.C. High School
Long Island City, New York

TEA'D OFF

John Dickinson complained that the high price of IBM's PS/2 Model 70-A21 was enough to buy "all the tea in China" ("The Best of 1988," *PC Magazine*, January 17, 1989). Does Dickinson realize that quality tea can be sold for as much as $1,000 for 16 grams in China? A more correct metaphor would have been, "The A21 is worth its weight in tea." I bet Dickinson is a heavy coffee drinker who has never been to China.

Jim Chiu
Irvine, California

PC Labs director John Dickinson replies: I drink my coffee black. Tea's good only for brewing strong metaphors to describe the best damned desktop 386 on the market.

NOT EXCELLENT ENOUGH

I enjoyed your awards for technical excellence, but I did not understand your choice of *ProComm Plus* as a finalist in the application software category.

I feel that *Telix*, Version 3.11, is a far superior product, with its 12 protocols and SALT, the very powerful, built-in script language.

Richard F. Eckert
Portland, Oregon

DENNIS RITCHIE: A GOOD CHOICE

I want to congratulate *PC Magazine* on its choice of Dennis Ritchie as the recipient of the Lifetime Achievement Award for Technical Excellence. This choice exhibits the true colors of *PC Magazine* by demonstrating that it is involved in the entire spectrum of computing.

Bruce Cohen
Staten Island, New York

CORRECTIONS/AMPLIFICATIONS

The ENVELOPE.COM program (Utilities, *PC Magazine*, December 27, 1988) failed to pop up on some computers. A new version, ENVELOPE 1.1, correcting this problem, is available on PC MagNet.

The CONFIG.CTL program (Utilities, *PC Magazine*, November 29, 1988) did not handle text strings correctly on some versions of DOS. A new version of CONFIG.CTL, Version 1.1, corrects this problem and is also available for downloading from PC MagNet.

The correct address for Guy Gallo, the author of the LaserJet 4.4 program ("Printing the Perfect Envelope," *PC Magazine*, December 13, 1988), is 219 E. 69th St., New York, NY 10021.

KJ Software is now KJ Inc. Its phone number is (602) 951-3995 (After Hours, *PC Magazine*, September 27, 1988).

The new Intel 80386SX processor runs at 16 MHz, not 12 ("Take It or Leave It: Portables with Desktop Power," *PC Magazine*, October 11, 1988).

HOW TO WRITE TO PC MAGAZINE

Send letters to *PC Magazine*, One Park Avenue, New York, NY 10016, or upload to PC MagNet (see the Productivity section for access information).

All letters become the property of *PC Magazine* and are subject to editing. ▣

most any system. Quietly.
that fits in a briefcase.

■ JOE DESPOSITO

PC ADVISOR

Changing print modes with pop-up software, locating a high-resolution paint program and 800 by 600 VGA adapter that displays 256 colors, and extending your keyboard cable.

POP-UP PRINT MODES

I want to change the configuration (switch to compressed mode from normal mode) of my printer with the help of a TSR program. Is there one to suit my needs?

Pierre Tocci
Montreal, Quebec
Canada

There are many public-domain and shareware programs that will do exactly what you want, especially if you have an Epson FX series or compatible printer. In fact, one of the PC Magazine utilities, SETUP.COM, is a pop-up program that will let you change print modes for Epson RX and FX series printers. SETUP.COM first appeared in the June 24, 1986, issue and is now available in the utilities section of PC MagNet. (Information about joining MagNet appears in the Productivity section of this issue.)

SETUP.COM can be modified to work with other printers too, but you will have to know the other printers' control codes. Directions on how to do this are located in the PC Magazine utilities file that is named MANUAL.

Some public-domain and shareware programs that can be used to change printer codes for Epson FX series printers are: Epshell, Epsonset, Nuepsn, and Rod-FX. The easiest way to get a program is to download it from a bulletin board. Distributors, who advertise copies of these programs for from $3 to $6, are another source.

A commercial program that will let you change print modes for a variety of dot ma-

trix and laser printers and do various other printer-related jobs is Printer Genius *from NOR Software (527 Third Ave., #150, New York, NY 10016; (212) 213-9118). Suggested retail price is $89.*

HIGH-RESOLUTION PAINTER

Is there a "capture-and-paint" program, like *PC Paint Plus,* for resolution higher than EGA?

Terry G. Meyer
Troy, Michigan

A good choice of a high-resolution paint program is Publisher's Paintbrush (a Best of 1987 product) from Z-Soft (450 Franklin Rd., Marietta, GA 30067; (404) 428-0008). It supports extended VGA (800 by 600 with 256 colors) as well as 8514/A (1,024 by 768 with 256 colors). It also provides support for several popular scanners. Suggested retail price is $285.

Keep in mind that you will have to use

■ You'll need the proper hardware to keep pace with *Publisher's Paintbrush;* for starters, it requires 1.5MB of expanded memory.

the proper hardware to keep pace with this software. For starters, Publisher's Paintbrush requires 1.5MB of expanded memory. Then you'll need either an extended VGA or 8514/A graphics adapter and a high-resolution monitor.

If you need any help in choosing equipment, you'll find reviews of expanded memory cards in the October 11, 1988, issue of PC Magazine, VGA adapters in the July 1988 issue, 8514 monitors in the February 14, 1988, issue, and multiscan monitors in an upcoming issue.

TOO SHORT FOR COMFORT

Is there any easy way for me to add an extension cable to a keyboard? I want to set my computer on the floor at a location that stretches the present keyboard cable.

Clyde T. Eisenbeis
Oakdale, Minnesota

What you need is a keyboard extender cable. This cable, which is more than 3 feet long, attaches to your current cable and then to the computer. The cable is available from many mail-order outlets and might even be sold in your local computer store. Jade Computer (4901 W. Rosecrans Ave., Box 5046, Hawthorne, CA 90251; (800) 421-5500) lists a keyboard extender for $12.

If you also need a monitor and power cord extender, you can get the complete set of three extenders from Global Computer Supplies (45 S. Service Rd., Plainview, NY 11803; (516) 752-2299). The set for the PC sells for $49.95, and the set for the PS/2 sells for $54.95.

■ PC ADVISOR

800 BY 600 VIDEO IN 256 COLORS

I am looking for a video board that can display 800 by 600 pixels with 256 colors at the same time on my multiscan monitor. The 256 colors should be from a palette of 256K (262,144) colors.

Patrick Lanz
Lausanne, Switzerland

Of the nine VGA adapters that were reviewed in the July 1988 issue of PC Magazine, *only one is capable of displaying 800 by 600 pixels with 256 colors from a palette of 256K.*

The board that can do this is the Designer VGA from Orchid Technology (45365 N. Port Loop West, Fremont, CA 94538; (415) 683-0300). However, the Designer VGA is not strictly VGA hardware compatible (although it is register-level compatible). The 6-inch card lacks a VGA-style Video Feature Connector—or any expansion connector at all. However, it does have 512K of 100-nanosecond memory. *Most of its capabilities derive from the Tseng Labs VLSI chip that it is built around and its Inmos digital-to-analog converter. Suggested retail price of the board is $399.*

RAM-RESIDENT GREEK

In the December 27, 1988, issue's PC Advisor Mr. N. Sampson of Darwin, Australia, asked about a Greek-language word

■ *Lettrix* is a memory-resident program that allows you to write in Greek and Hebrew.

processor. *Lettrix* from Hammerlab Corp. (938 Chapel St., New Haven, CT 06510; (203) 624-0000) is a memory-resident program that operates with other word processors such as *WordPerfect*. It allows you to write in Greek, Hebrew, and Cyrillic, as well as a number of other fonts. This allows you to keep your existing word-processing software. The program also improves the quality of printing on some dot matrix printers.

Leland Gilsen
Salem, Oregon

Thanks for the information. Suggested retail price of Lettrix is $98.50.

ASK THE ADVISOR

Send your questions to PC Advisor, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload to PC MagNet (see the Productivity section for access information). Please specify your equipment. ▧

4 Ways To Share Laser Printers

HP LaserJet Series II D™ resident selections are a keystroke away, no matter what applications you're using, and this capability is available for every major brand of printer.

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Full desktop publishing	Y	Y	Y	Y
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Ports	8–32	6–16	6	4
AutoInstall	Y	Y		
Copies	Y (collated)	Y		Y
Popup operations, RAM resident and non-resident	BigPop	SmallPop		LaserPop
Job cancel	Y	Y		Y
Automatic form feed	Y	Y		
Forms overlay printing	Y			
Text enhancement	Y			
Font management	Y			
Resource utilization reports	Y			

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CompuStar®
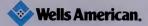
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PC MAGAZINE FIRST LOOKS

Wolfram's Mathematica: Wonderful, Revolutionary, and Bug-ridden

PC HANDS ON

BY BARRY SIMON

For months now, with more than a little amusement, I've watched normally sober mathematicians rave over the "wonderful and revolutionary" *Mathematica*. Waiting for the PC version to ship (Sun and Macintosh versions have been available for some time), I've assured myself that I'm too jaded for such outbursts and above such undignified prattle. But, alas, I can't help myself: *Mathematica*, MS-DOS 386, Version 1.1, is wonderful and revolu-

tionary, for what it promises to be if not for what it is.

Mathematica has neither the elegant interface of *MathCAD* nor the blazing speed of *Gauss* (see "Better Tools for Higher Math: When Numbers Count," *PC Magazine*, March 14, 1989). What sets it apart from PC mathematical software is what it can do with math.

First of all, it will do arbitrary accuracy integer and rational arithmetic. You can ask it what 1,000 factorial is and it will spew out the answer exactly, in roughly 2,500 digits. You're not likely to want this

Mathematica generates two- and three-dimensional PostScript graphics.

Paradox 3.0 Gives Users a Few New Good Reasons to Switch

PC HANDS ON

BY RICHARD HALE SHAW

Are you looking for a solid, sophisticated database management system with the strength and elegance of a fine building? How about a DBMS that, rather than becoming clumsy and bug-ridden, continues to mature with each new release? Then take a long look at the latest version of *Paradox* from Borland.

Relational database pundits are already familiar with *Paradox*'s full-featured PAL programming language, the Data Entry Toolkit for designing forms and interfaces, and the Personal Programmer application generator. *Paradox*'s pow-

erful QBE (query by example) uses intelligent query optimization to find the most efficient data path, and then places results in a table. With *Paradox*, the finer details of database management are taken care of for you, and you don't have to deal with *anything* but tables.

Now, *Paradox* 3.0 adds several welcome enhancements, including new QBE commands, data cross-tabulation, and instant graphs. It also includes facilities for manipulating multitable relations and creating multiform data entry screens.

Among the more-enticing QBE additions are outer joins and set operations. An outer join is a relational database construct that allows you to select

every record in two related tables. Most DBMSs allow you to select only related records. With *Paradox* 3.0, the solution is simple: add an exclamation point to one of the fields in the QBE selection form.

Paradox 3.0's set operations allow you to define sets of records that can be compared with other records. Suppose you need to find all customers who've ordered $500 or more of a product, and the customers and orders are kept in separate but related tables. You can easily issue a single query to find the sets of orders that qualify and the customers who placed them.

Other QBE enhancements: You can request only those rec-

ViewLink: The First of a New Breed

BY LORI GRUNIN

Traveling Software's $150 ViewLink may give you a whole new perspective on managing and using your files. Along with Lotus's forthcoming product Magellan, ViewLink is at the forefront of a new wave of software designed to circumvent the arcane ways of DOS.

ViewLink lets you organize and view the files on your hard disk in much the same way that Lotus's Agenda lets you organize and view bits of text: seemingly unrelated "items"—usually files in the case of ViewLink—can be grouped into "views" that better reflect the way you work.

ViewLink also provides an assortment of DOS functions. For instance, you can launch an application by choosing a file you want to work with.

During installation, ViewLink searches the path you've specified (it can search across drives) and creates a "view" corresponding to each subdirectory; files from each directory become "items" for that view.

ViewLink lets you group lists of files by content, date, name, and type.

It also creates a view comprising all the applications it recognizes and, by reading the first 120 characters of each file on your disk, recognizes user files that belong to each application and links them accordingly.

You can add your own views, linking files from as many different subdirectories and applications as you see fit. Every item includes a box for notes.

Once you're up and running within ViewLink, the left half of

the screen displays your list of views. Highlight a view with the cursor, and the right half displays the names of items belonging to that view.

If an item is an application file—a Lotus 1-2-3 worksheet,

for instance—ViewLink starts the application and loads that file. You can run several applications sequentially by tagging several items. ViewLink also lets you cut and paste between applications and record keystroke macros.

If ViewLink doesn't recognize a given application during installation, you'll have to define the application yourself. ViewLink currently comes with startup macros for more than 40 common applications. Writing macros for unsupported programs is relatively simple.

For those times when you need to browse a file but don't want to go through the trouble of starting an application, ViewLink will display text files and, if you've got The Norton Commander's 123VIEW or DBVIEW, it will also display DBF or WKI files.

One problem of programs designed to help you deal with large amounts of information is keeping the program up-to-date. ViewLink solves this problem, though not always with optimal results.

Aside from manually creating a link for a new file when you create it (a whopping two

keystrokes), you can keep views apprised of new files via "Autolinking" or "Autoupdate" variables. With the Autolinking option on, ViewLink automatically searches new files you save for words or phrases that match a view name.

This approach is not flawless. If you refer to Mr. McCullers as "the boss" in your file and forget to add his name elsewhere, you've lost the file from the McCullers view. Autolinking also slows application-jumping considerably. While bearable on an 8-MHz AT, on an XT it took so long to close a file that I was convinced the machine had locked up. The more views you have, the longer it takes.

Alternatively, you can define the Autoupdate variables to update a view based on criteria such as a search string, filename, or modification date.

Traveling Software is already working on Version 1.1 of ViewLink, which will include LIM EMS 4.0 and mouse support.

ViewLink is certainly one of the most useful shells I've seen. It is good for those who opt for ease of access over speed and who constantly find themselves slamming against the barrier between the way they think their files should be organized and the way DOS does organize them.

Magellan Takes a Different Tack

Magellan, Lotus's $195 soon-to-be-released file-search software, provides the same file grouping and launching capabilities as Traveling Software's ViewLink but takes an entirely different approach.

Magellan, as its name implies, explores, rather than organizes. The program indexes your hard disk(s), so that it can quickly find files that contain bits for a given query. You can save the results of such searches as "groups," conceptual kin to ViewLink's "views." Magellan, however, displays the file highlighted in the list on the left side of the screen, rather than just a brief description of it.

Some operations, such as application launching, work more or less the same in both programs. But in many ways Magellan is more sophisticated than ViewLink—it can, for instance, find all the files similar to a chosen one. It also lets you slice, dice, and splice your files more easily with its Gather command, and it doesn't rely on third-party viewers to display nontext files.

Ironically, however, some of Magellan's search capabilities seem more limited than ViewLink's, at least in our early preview copy. It can't search files by their creation or modification date and has no real way of performing Boolean operations.

Their names really say it all. ViewLink helps you visualize the relationships between your files—it's meant for people who like to categorize and who always need to know where everything is. Magellan, on the other hand, is for those who don't care where anything is, as long as they can find it when they need it.—Lori Grunin

Paradox
(continued from page 33)

ords that match a field in the query. Or, you can select the set of records that contains either of two values in a field.
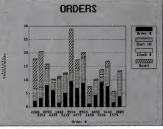
Building on an already strong relational interface, *Paradox* 3.0 improves the way you express and manage relationships between different tables. You can create a multitable form in which records from several related tables are simultaneously displayed. For instance, if an order-entry system uses related tables, the currently displayed customer record will automatically control which records appear from the orders table. Multitable forms allow you to designate a "scrolling region" so you can page through and edit the records of a table from an application. *Paradox* 3.0 lets you link multiple tables on a one-to-one or one-to-many basis. You can create easily a single form for entering or displaying data.

Paradox 3.0 correctly maintains relationships between related records in linked tables. If your application changes a record in one table, *Paradox* automatically updates the corresponding values in records of a related table. It also won't let a "master" record be deleted if it is related to records elsewhere.

Paradox 3.0 also sports cross-tabulation, so you can ac-

cumulate and summarize numeric data across several rows and columns of a table. You can store this summary in a table or display it in an instant graph.

Instant graphs are without question the hottest new feature of *Paradox* 3.0. The steps required to generate a graph are simple: select a table, select the columns to appear in the graph, and press the "graph key" (Ctrl-F7). You can generate bar

ORDERS

Paradox 3.0 lets you produce complex graphs in only a few keystrokes.

charts, line graphs, *x-y* graphs, and pie charts, to name a few. And, you can modify the colors, define the labels, and choose the fonts. Each graph specification can be saved.

Paradox arrives on 15 5¼-inch or 8 3½-inch disks. This includes sample applications,

the Data Entry Toolkit, and the Personal Programmer. While the minimum configuration occupies 1.5MB of disk space, the fully installed program will eat up 4.5MB. Fortunately, the installation program makes it easy to select only the essential portions of the package if you're short on disk space.

If you don't care for the default color scheme (I didn't), you can change the colors of

more than two dozen different screen components. Additional enhancements found in *Paradox* 3.0 include support for LIM 4.0 EMS, and the ability to import and export *Quattro* and *Reflex* files. And, although *Paradox* 3.0 requires a hard disk, Borland still sells *Paradox* 2.0

at a lower cost for owners of floppy-disk-drive machines.

Borland has indicated its commitment to the future of *Paradox* by announcing connectivity to several SQL servers. Since QBE will be used as a front end, *Paradox* users can take advantage of this feature without learning SQL. Also, Borland's new *SideKick for Presentation Manager* uses *Paradox*-compatible data tables.

Paradox has consistently outclassed the competition, and this update continues the tradition. *Paradox* 3.0 is a powerful, easy-to-use DBMS that packs a lot of bang for the buck.

Benchmark Tests:
Paradox 3.0 vs. Paradox 2.0 and dBASE IV

*P*aradox 3.0's dramatic improvements over *Paradox* 2.0 are partly the result of a careful use of the Paradox Application Language. Since *Paradox* is a set-oriented database and the benchmark tests are designed for record-oriented databases, results can be misleading when compared with a "one-record-at-a-time" DBMS like *dBASE IV*. All tests were performed on a 50,000-record file.
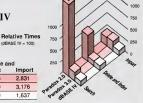
The **Search** test measures the time it takes to locate the first record that satisfies two criteria (make = Fendhi and model = coupe).

The **Delete and Index** (four-column version) test measures the time required to remove four columns (Units, SellPrice, BuyPrice, and

Performance Times
(Times given in seconds)

	Search	Delete and Index	Import
Paradox 2.0	376	3,346	2,831
Paradox 3.0	18	659	3,176
dBASE IV	10	619	1,637

Relative Times
(dBASE IV = 100)

TranDate) from a Product table created for this task, and then to reindex the file if necessary.

The **Import** test measures how quickly the database can import an ASCII file (of either fixed field length or comma-delimited format) with an index on the first field. We include the indexing

portion of the test to avoid penalizing programs that automatically index the first field during the data conversion. Some programs require a two-step process for this test: an import followed by indexing.

Mathematica
(continued from page 33)

number of digits on a regular basis, but the ability to keep all digits avoids round-off errors that plague other packages.

Mathematica will also deal with reals to arbitrary accuracy, subject to time and memory constraints. If you ask it N(pi,500), it will display the first 500 decimal places for pi.

Second, *Mathematica* performs symbolic manipulation. It will combine rational and trigonometric expressions and

The DOS version of Mathematica *offers only a command-line interface.*

simplify them. Whereas most other programs will compute only numerical integrals and derivatives, *Mathematica* computes integrals and derivatives in functional form. Such abilities have been available on mainframes and minis for the past 10 years but, other than the limited *MuMath* program, this is the first time such power has been available on the PC.

Mathematica comes with a rich array of built-in functions, including a variety of elliptic and hypergeometric functions, all in the complex domain. It will compute prime factorizations of integers, but once the integer is more than about 20 digits, the times involved become enormous. It will factor polynomials. If you try to solve a polynomial equation and the answer can be expressed exactly in radicals, *Mathematica* will do that as well as evaluate the numerical answer.

At the heart of all this power lies a built-in language that

combines elements from C, LISP, and APL. You can define functions procedurally or with rule-based definitions. For example, to define N factorial, you could just tell it the rules F[N] = N F[N-1] and F[0] = 1, rather than set up an explicit recursive procedure.

Mathematica can accept sets of routines, or "packages" from third-party vendors. Packages planned or already available deal with subjects ranging from the esoteric—like Galois number field—to the practical—like statistical analysis.

In addition to its number-crunching skills, *Mathematica* boasts truly outstanding graphics. It generates graphs using its own implementation of a PostScript subset, so it's easy to import its graphs into desktop publishing programs. It comes with printer drivers for a number of non-PostScript printers including the HP LaserJets. It also interfaces with TeX, Knuth's typesetting language.

The Bad News
All versions of *Mathematica* have two parts: a machine-independent kernel that holds the mathematical part of the program and a machine-dependent front end. The kernel has already been honed on Suns and the Mac, so it is Version 1.1 of the kernel that is included in the first 386 version. A 750-page hardcover textbook—included with the program but also available in scientific bookstores—describes the kernel.

The machine-specific front

end is where the problems start to show in the MS-DOS version.

To begin with, the program requires an 80386-based computer and at least 1MB extended RAM above 640K. There are versions for use with no coprocessor, and for an Intel math coprocessor, and for a Weitek coprocessor. In addition to the 3.5MB of disk space that the program files take, you'll need 3MB of free disk space or, preferably, RAM for swapping. While these hefty system requirements will undoubtedly scare off many prospective users, they aren't unreasonable, given the amount off power *Mathematica* provides.

Another problem lies within the user interface. While the Mac version sports pop-up menus and the like, the DOS version gives you little more than an editable command line at the bottom of the screen—not unusual for mathematics programs but less than you might expect for a modern application requiring a 386 machine and lots of RAM.

Worse still is the number of bugs in this initial DOS release. The program uses Phar Lap's *386/DOS-Extender*, which lets you transparently run *Mathematica* at the DOS command line with access to extended memory. The initial run of *Mathematica* shipped with a beta version of the Phar Lap software, which doesn't work with *386-to-the-Max* or *QEMM-386*, although these memory managers are compatible with Phar Lap's specification. This problem should be resolved by the time you read this. However, it seems improper for Wolfram to have shipped a product with a beta version of a third-party component.

If your system crashes when you are running *Mathematica* or if you turn it off because a calculation is taking too long, you'll need to be sure to run CHK-DSK, since it then leaves a 3MB unallocated chain.

On my Genoa EGA, I found a harmless but annoying bug that had the cursor dance all over the screen every time I hit the Return key. And in the noncoprocessor version, I found a

serious linear algebra bug that consistently gives the wrong answer in inverting certain large matrices (18 by 18 and above). To put this bug in perspective, any program that doesn't use arbitrary precision arithmetic would have serious round-off errors beginning with matrices of about 12 by 12. But since the answers in *Mathematica* are supposed to be exact, this error is of concern.

It is regrettable that Wolfram Research is apparently willing to use the initial purchasers of *Mathematica* as paying beta testers, but the power of the product is so enticing that you may want to put down your money anyway. Once Wolfram irons out the kinks, anyone with the necessary hardware and a need to do serious mathematics on a PC will want this program. ▣

OmniPage: OCR Made Easy, Affordable

PC HANDS ON

BY TOM STANTON

Caere has sold recognition products ranging from bar code readers to point-of-purchase OCR for years. The OmniPage is its first OCR for PCs and, based on initial tests, my complaint is that the company didn't enter this market sooner.

The heart of the OmniPage

immediate feedback for a go/no-go decision for most pages. You can determine right away whether the page is too dark, too light, skewed, folded, or even if you've scanned the wrong page. It recognizes nearly any nonfancy font.

Unlike most OCR packages, the OmniPage can store scanned text, columns and all, in the format of your choice. The Omni-Page supports almost every doc-

mentary but adequate. You can scan and save a whole page or scan and select an image window and save. Controls include resolution, brightness, inversion, mirroring, line art, and two halftone dithering patterns—high contrast (fatting) and higher resolution (bayer). The OmniPage provides no image editing except cropping.

Scanner and format settings can be stored in command files for specific document or image types, or you can set them on the fly to suit a page. You can also run the OmniPage firmware in the background, but doing so slows down foreground tasks considerably.

Command Performance

With the OmniPage I scanned the opening page of First Looks, a good all-purpose page with large type, logos, reverse type, two separate stories, an index, and pictures—nice to read but a bear for OCR.

The OmniPage broke the page into 22 separate zones most of the time. In some cases it combined the caption with the body text, but generally it isolated most textual elements correctly. It even tried to recognize text from a screen shot.

The automatic sequence for zones is not always correct, so the OmniPage lets you select specific zones and the sequence. Using the same page, I selected the headline, the upper four columns, and the captions, and I numbered them in sequence. The OmniPage read each zone successfully, in order. When I tried this task using Multipage Scan I got a surprise: the selected zones and sequence remain in effect until you've finished. This "surprise" actually works great with forms, but for complex magazine pages you'll need a file per page.

Outputting to WordPerfect 5.0 format, the OmniPage did a good job with most format codes, though it occasionally lost track of text attributes if it encountered an unrecognized character at the same time.

To test the financial format,

I scanned two different tables and imported them into Excel. One table worked well, but the other merged two columns during recognition, apparently as a result of an undocumented minimum column width.

Caere needs to add more drivers to support other scanners, and its documentation is almost too simple. Specific instructions for scanning spreadsheets, databases, listings, and other types of documents would be nice, and technical details like the supported TIFF format could save someone a lot of work. Overall, however, I enjoyed using the OmniPage, and the Windows-based firmware is so easy to use that I found little need for the documentation.

If you've been considering OCR for fax, desktop publishing, or data entry, the Omni-Page may offer the best mix of features and price. It's versatile, well-automated, and thoughtfully engineered, making it a practical solution for the office. Your only problem may be waiting in line to use it. **PB**

The OmniPage breaks pages into numbered zones that separate, for example, text from graphics and headlines from subheads.

OCR system is a full-length board with 2MB memory, a dedicated 68020 processor, and proprietary character recognition firmware. Connected to one of the three scanners it supports—the HP ScanJet or the Canon Image Scanner IX-12 or IX-12F—the OmniPage creates an excellent office OCR system that's easy and fun, to use. The package can also work without a scanner, by importing uncompressed TIFF files.

The OmniPage first scans in the page and then breaks it up into reading zones using an internal parsing scheme. You see the whole process on the Microsoft Windows–based screen. First a rough page appears, then frames for each zone. The OmniPage numbers the frames to show sequence, and then text recognition begins. Zones are shown in reversed video during recognition, and a character window shows the current quality of the scanned letters.

This simple system provides

ument format available and can output text in a single column or in multiple columns, if your word processor supports them. Text attributes like boldface, italic, and underline are also carried over to the output. The package includes a simple editing program, but you can modify text only if you're outputting to ASCII.

The OmniPage provides recognition statistics at the end of the process. Each unrecognized character is stored as a tilde. On average, the OmniPage gets 96 percent of text correct, but sometimes automatic sequencing of recognition zones fouls up pagination.

The OmniPage also supports a generic financial format for spreadsheets, tables, or reports in tabular columns, and it offers output to Microsoft Excel or Lotus 1-2-3 format.

In addition to its OCR acrobatics, the OmniPage can scan images and store them as TIFF files. Image scanning is rudi-

PC MAGAZINE PIPELINE

1 Lotus 1-2-3 2.01
Lotus Development Corp.

2 Quicken 2.0
Intuit

3 WordPerfect 5.0
WordPerfect Corp.

4 The Norton Utilities
Advanced Edition 4.5
Peter Norton Computing

5 Value Pack
Lotus Development Corp.

9 Sideways 3.2
Funk Software Inc.

7 Carbon Copy Plus 5.0
Meridian Technology Inc.

9 Microsoft Works 1.05
Microsoft Corp.

9 Dac Easy Accounting 3.0
Dac Software Inc.

10 Microsoft Excel 2.10
Microsoft Corp.

Lotus 1-2-3 is still holding on to the top spot, but it's not an honor that's coming cheaply to Lotus. For the last quarter of 1988, Lotus posted sales that were essentially the same as the year before, while the company's earnings dropped by 60 percent from the previous quarter, reflecting the cost of promotions to bolster the spreadsheet's sales. Lotus's *Value Pack*, for example, is reaching thousands of *1-2-3* users, but the company is giving it away, collecting only a small service charge for the disk. And new copies include an extra bonus: Funk's *Always*.

Meanwhile, Microsoft had an especially good week; *Microsoft Excel* is starting to benefit from price promotions that just went into effect. *Microsoft Works*, on the other hand, is selling well completely on its own merits.

READING THE CHART

The Top Ten Sellers list ranks PC business programs according to their sales totals in the week ending January 21. The chart that appears to the left of each program's name shows how the program's sales ranked each week for 5 weeks. The hash marks at the bottom of each chart represent each of those 5 weeks, beginning with the week of December 19. Dramatic shifts in a particular program's ranking may be the result of seasonal factors or sales promotions conducted by individual retailers. More than 12,000 individual locations contribute to the list.

Rankings are based on net sales by unit; returns are subtracted from gross sales.

Sales information compiled by Ingram Software Inc. and PC Connection Inc.

PC MagNet SURVEY

The topic was SQL multiuser databases. Callers to PC MagNet were queried on the importance of SQL and the overall concept of distributed databases. Their responses show a strong interest in migrating toward such a wide-platform application, spanning PCs, minis, and mainframes.

As the results at right indicate, decision makers don't want that progress to come at the expense of losing their significant investment in *dBASE* applications.

How important is the ability of existing *dBASE* applications to access distributed data?

Don't know **7%**

Not important **9%**

Somewhat important **43%**

Very important **41%**

OSF CHOOSES A FUTURE LOOK FOR UNIX

If Unix ever settles down and becomes a popular operating system, it may owe its look to the installed base of *Microsoft Windows* users.

OSF (Open Software Foundation), the consortium that IBM, DEC, and a number of other hardware vendors recently formed to develop a Unix graphical interface, chose a couple of standards recently, and Microsoft's design plays the most visible role.

By the end of the year, OSF plans to distribute source code for its Unix front end that will be based on a combination of the *Microsoft Windows* *Presentation Manager* design and DEC's implementation of X Windows. Software publishers will then write applications that run under Unix System V, Release 4, with the OSF front end acting as the graphical interface.

The choices reflect the success of *Windows* as an interface (more than 2 million copies have been sold) and the popularity of DEC's X Windows tool kit as a programming interface.

There's no reason to sound the death knell for DOS, OS/2, or other competing operating systems, but the quick action by OSF gives Unix its best chance yet to stabilize and reach a broader market.

For example, several days after OSF announced its choice, NASA's Goddard Spaceflight Center joined the foundation, saying it wanted to help the operating system grow. That's a good sign for Unix because, until now, OSF has been largely driven by vendors, not users. According to the center's director, "Unix has so far been a disaster

because of the incompatibilities in the different versions."

If this does represent real progress, it means AT&T is losing its sole control over Unix; it had proposed a competing application interface, Open Look. AT&T recently separated its Unix development from its hardware operation as a way of allaying fears that the operating system was being used to help AT&T sell hardware. AT&T says Open Look is still on track, but it's hard to see both standards surviving.

If Unix is ever to break into

mainstream use, it will have to cut its apron strings to AT&T. DOS flourished only because Microsoft had no conflict of interest: it was eager to sell the operating system to any hardware vendor.

Unix, lacking a credible backer, faces greater obstacles, but the interest is growing. A recent poll by Techtel of Emeryville, California, found interest in Unix among PC buyers had grown from 5 per-

cent in October 1987 to 15 percent a year later.
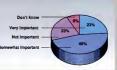
Momentum Building for the X.400 E-mail Standard

In 1984 the CCITT (the French abbreviation for International Telegraph and Telephone Consultative Committee) approved a protocol for message transfers between e-mail systems called X.400. In 1989 that standard may finally bear fruit.
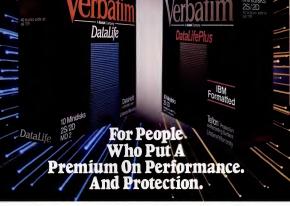
Dialcom and AT&T recently agreed to build an X.400 link between their systems, giving subscribers to each service the ability to direct mail to someone

on the other service. The systems have a combined installed base of over 180,000 users.

You can expect to see other e-mail systems announce new services throughout the year as they implement the X.400 protocol, which specifies how messages should be packaged when transmitted between dissimilar computers.

The next step, still several years away, is the implementation of the CCITT's brand-new X.500 protocol, which will make databases of e-mail subscribers feasible. An X.500 directory could overcome the barriers between systems and make e-mail as universal as postal mail.

IBM Hasn't Given Up On the Portable Market Yet

Rumors are again surfacing that IBM will soon enter the portable PC market for the third time. The PC Convertible, its second try, has been discontinued and discounted.

A number of prototypes for the third try have been shown to key customers, but it's not clear who would be chosen—if any.

There's strong evidence that IBM was planning to unveil an AC-powered 286-based portable last fall but pulled back after it saw the Compaq SLT/286.—Gus Venditto

> The quick action by OSF gives Unix its best chance yet to stabilize and then reach a broader market.

How important is the ability to connect *dBASE* applications to a multiuser SQL database server?

Don't know	9%
Not important	16%
Very Important	33%
Somewhat Important	42%

How important is the ability to exploit the power of SQL now?

Don't know	8%
Very Important	23%
Not Important	23%
Somewhat Important	46%

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Intel Visual Edge, DP-Tek LaserPort Boost HP LaserJet Gray-Scale Abilities

PC HANDS ON

BY EDWARD MENDELSON

Without moving an inch from your desk, your laser printer can take a giant step in its evolution into a printing press.

With Intel's $695 Visual Edge enhancement board (or its close relative, DP-Tek's $685 LaserPort board), an HP Laser-Jet Series II can print photographs and similar gray-scale images at four times more resolution than before—and, as a bonus, can print them three times faster.

A typical image printed via

the Visual Edge system has 64 shades of gray at 70 lines per inch. The lines per inch can be expanded to 100 if the gray scale is reduced to a still-acceptable 37 shades. While hardly perfect, this range approximates the quality of newspaper halftones and produces images that retain their clarity in a copying machine.

By comparison, a standard laser-printed photograph with 64 shades of gray has only a coarse 38 lines per inch, while a 100-lpi image has only 10 shades of gray.

The technology that does the trick was developed by DP-Tek for the LaserPort and licensed by Intel for the Visual Edge. The two systems produce identical results.

Most users will prefer the Intel version, which is designed more for the end user than for OEMs (original equipment manufacturers) and VARs (value-added resellers), but the DP-Tek version has unique options that for some users will make it the only choice.

Both systems consist of a short expansion card that fits into an 8- or 16-bit slot of an AT or compatible and a small card that fits into the I/O option slot of the HP LaserJet Series II. A video cable sends graphics output from the board in the computer; while the parallel or serial port that you normally use for printing continues to be used for text. Inside the printer, text and graphics are combined to print on the same page.

Both systems need at least 1MB of EMS RAM in which to store and process images. The Visual Edge works with any flavor of EMS, but the LaserPort can work only with EMS created in hardware, not by EMS emulators or 80386 memory managers. The Visual Edge works with only the HP LaserJet Series II, but the LaserPort has an option that lets it work with the original LaserJet or LaserJet Plus. Neither of the boards

works with the new LaserJet Series IID—yet.

Each system works directly with Ventura Publisher, Page-Maker, and other Microsoft Windows applications and with Z-Soft products like Publisher's Paintbrush. Once you install the system, the application uses

it automatically, and you never have to think about it again. But you have to give up all print spoolers or buffers before the system will work.

The picture quality you can get from the Visual Edge depends on the application that sends the picture through the system. With Ventura Publisher 2.0 the Visual Edge can produce fine newspaper-quality images because Ventura starts out with impressive gray-scale capabilities built in. Page-Maker, in contrast, starts out with relatively primitive gray-scale capabilities. When you use PageMaker with the Visual

Edge, the images that result are about equal in quality to those that Ventura produces on its own.

The Visual Edge also comes with a memory-resident EMS graphics manager that adds indirect support to Lotus's Freelance Plus, Software Publishing's Harvard Graphics, and Ashton-Tate's Chart-Master. The LaserPort board includes software that lets advanced users integrate the system into any program that allows direct entry

The top picture was printed using the Visual Edge system. The bottom is ordinary HP LaserJet output.

of LaserJet escape codes. The LaserPort also has utilities that let you print images from the DOS command line.

The next giant step in the evolution of the laser already on your desk may be DP-Tek's forthcoming LaserPort Gray-Scale board. For $1,295, this product will give LaserJet images an impressive 212 lines per inch and 512 shades of gray. This level of performance elevates laser images to the quality of book publishing. Meanwhile, the Visual Edge and the current version of the LaserPort bring those images to an impressive level at a reasonable cost.

HP LaserJet Supercartridge, Font Generator

PC HANDS ON

BY EDWARD MENDELSON

Sooner or later every HP LaserJet owner succumbs to font fever, a condition marked by an insatiable desire for new typefaces. Even the worst sufferers from this painful condition now have two new ways to satisfy their craving. Help has arrived in the shape of a font generator and a supercartridge, both authentically Hewlett-Packard.

matching screen fonts.

Type Director includes support for Microsoft Word, Versions 4 and 5, and support for WordPerfect 5.0 in forthcoming. Programs like *Manuscript* and *WordStar*, Release 5, can also use *Type Director* fonts; and if you know how to use escape codes, you can use the fonts with any other application that supports the LaserJet.

HP's *Type Director* competes directly with Bitstream's identically priced *Fontware*

has no comparable custom options.

HP's includes downloading and other functions that you won't find in Bitstream's. And unlike Bitstream's, HP's lets you install fonts from any third-party source into your applications, even if the fonts weren't made by *Type Director*. Bitstream's font generator can create PostScript-compatible soft fonts. HP's can't.

Both programs create standard LaserJet printer fonts, but

of IQ Engineering's Super Cartridge 1, Hewlett-Packard now offers a 65-font cartridge called the HP ProCollection. At $300, it holds most of the fonts that most users will ever need.

For proportional fonts, the ProCollection uses Bitstream's versions of Times Roman and Helvetica in sizes ranging from 8 to 14 points. Fixed-pitch fonts include Prestige Elite in 7 and 10 points, Courier in 10 and 12 points, and Line Printer in 8.5 points. Letter Gothic comes in surprisingly legible 3.6- and 6-point sizes for printing monster spreadsheets on a single page as well as normal 9.5- and 12-point sizes.

All fonts include the standard ASCII characters; most add a few legal symbols. The proportional fonts come in portrait orientation only, while the fixed-width fonts come in both portrait and landscape modes.

The ProCollection isn't a direct substitute for existing HP cartridges. But that shouldn't keep you from buying it. The HP label guarantees that every major application will provide support for the ProCollection within a matter of weeks.

Letter Gothic	3.6 point	6 point	
Line Printer	8.5 point		
Courier	10 point	12 point	
Courier Bold	10 point	12 point	
Courier Italic	10 point	12 point	
Prestige Elite	7 point	10 point	
Prestige Elite Bold	10 point		
Prestige Elite Italic	10 point		
Letter Gothic	9.5 point	12 point	
Letter Gothic Italic	12 point		
Tms Rmn	8 point	10 point	12 point
Tms Rmn Bold	10 point	12 point	
Tms Rmn Italic	10 point	12 point	
Helv	8 point	10 point	12 point
Helv Italic	10 point	12 point	
Helv Bold	12 point	14 point	

Hewlett-Packard's ProCollection supercartridge includes 65 HP LaserJet fonts.

Type Director

Licensed from Agfa Compugraphic, HP's $95 *Type Director* creates, manages, and installs LaserJet soft fonts in any size from 5 to 200 points.

You create fonts by combining the *Type Director* program with typeface outlines sold by HP and Agfa Compugraphic in $195 packages that include four outlines each. A typical outline package contains raw data used for generating fonts in a related typeface like the roman, italic, bold, and bold italic varieties of Garamond. HP sells a $225 *Premier Collection* package, which includes *Type Director* plus three outline packages.
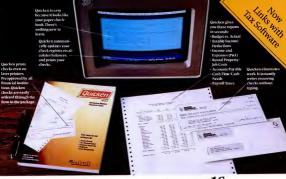
The program installs fonts for instant use in Ventura Publisher, PageMaker, and other applications that run *Microsoft Windows*, complete with

and, for the most part, wins. The most impressive difference between the two systems is speed. If you don't have a math coprocessor chip in your machine, HP's creates and installs fonts five times faster than Bitstream's. If you have a math coprocessor, Bitstream's closes the gap but still runs at half HP's speed.

HP's lets you install the same fonts in more than one application from a single menu. Bitstream's makes you use separate installation programs for WordPerfect, Word, PageMaker, and Ventura Publisher. HP's offers a choice of 16-character sets; Bitstream's offers 3 or 4. When you want to use enormous fonts that occupy acres of disk space, HP's lets you generate only the characters you actually need. Bitstream's

tions to the lineup.

In the end, what matters most is the quality of the fonts you see on the page. The Compugraphic fonts aren't better or worse than Bitstream's—but they're significantly different. Compugraphic's version of Times Roman is a dark, narrow face that works best in narrow columns but looks cramped when printed across a full page. Bitstream's version of Times Roman is a lighter, more open face that looks best when set across the page but seems too loose for narrow columns. Your choice depends as much on personal taste as on the kind of work you do.

HP ProCollection

If you don't want to generate a few dozen fonts, just plug them in. Following in the footsteps of

$13,000 Tektronix Phaser Delivers 300-dpi Color PostScript/HPGL

PC HANDS ON

BY GERARD KUNKEL

If you've been waiting for a high-quality color printer at a justifiable cost, wait no more. The Tektronix Phaser Card PostScript/HPGL adapter and Phaser CP color thermal wax

penalty is minimized; color output is not much slower than black-and-white laser output.

The $6,000 300-dot-per-inch Phaser CP is the color thermal wax transfer engine in the family. This is a big machine. You may consider giving it a table all its own. And don't begin to imagine that it's portable.

transfer laser printer team up to produce outstanding color hardcopy at a reasonable $12,995.

The 8-bit Phaser adapter card installs in a standard AT bus and boasts 8MB of RAM for the PostScript interpreter, one port for the Phaser CP, and another for an optional black-and-white laser printer. Since the PostScript interpretation takes place on the Phaser Card in the host computer, most non-PostScript-compatible laser printers will work. At $6,995, this interpreter board is a bargain when you consider its power.

Because PostScript processing is done in the host, the speed

Moving the printer across the room becomes at least a two-person challenge. With this kind of color output, though, you won't mind the backaches.

If you already have a Tektronix 4693D or DX, the Phaser Card will give you PostScript compatibility without having to purchase the Phaser CP print engine.

Setup for the Phaser system is a breeze. The adapter comes with a complete set of documentation to help change jumpers if you encounter interrupt conflicts with mice, network cards, or other adapters. Follow a simple set of menus to install the

software and utilities; update your AUTOEXEC.BAT file, hook up the provided cable, and color prints can start to flow.

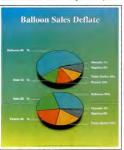The Phaser Card interprets all of the standard PostScript operators. In addition, the Card interprets the extended color PostScript operators, including "setcmykcolor." When printing to the optional black-and-white printer, the Phaser Card translates the color values into the appropriate gray values.

The Phaser CP offers a four-pass cyan, magenta, yellow, and black ribbon, or a three-pass magenta, yellow, and cyan ribbon. Fortunately, the CP contains the electronics to understand which ribbon has been installed, and no user intervention or software setup is necessary.

Tektronix recommends using the latest version of the Micrografx PostScript driver for Windows. The driver is bundled with the installation software.

Like most other PostScript printer clones, the Phaser offers the standard 35 resident fonts. Resetting the font matrix directly in PostScript code proved the system to be fast and reliable.

Every new system has some room for improvement. In the case of the Phaser, downloadable fonts is the area. Currently, the system provides support for Bitstream type 3 downloadables without fonts (intelligent scaling information). Ideally, the Adobe downloadable outline fonts with hints would be fully supported.

Another caveat, with a planned resolution, is networking support. Right now the Phaser system supports only 3Com networks. This system is best utilized in a networked environment. At $13,000, and about $1 per output page (quality paper is expensive, and so are the ribbons), it would be a waste to put this device in the hands of only one person.

There are already a significant number of popular software packages that will support

the Phaser, including *Page-Maker 3.0*. Other programs such as *AutoCAD* can drive the Phaser using HPGL. And if high-quality acetate transparencies for overhead projections are your game, try *Harvard Business Graphics* or *Micrografx's Windows Graph*.

The complete Phaser family of PostScript/HPGL output solutions was to include the Phaser LP, a 300-dpi B-sized, black-and-white printer. Contrary to other press coverage, Tektronix will not be offering this printer but will be supporting other popular A- and B-sized black-and-white laser printers through the Phaser Card's parallel port.

Tektronix is also offering a Macintosh version of the Phaser system—called the Phaser Color or PrintStation—for $15,995. In addition to everything available in the PC-based product, the PrintStation has a 40MB hard disk and hooks directly into AppleTalk as a print server.

The Tektronix Phaser family of products marks an important price-performance breakthrough in the PostScript color printer arena. Since the system lives in both IBM- and Apple-compatible environments, it is a natural for workgroup systems that use 3Com as the bilingual interpreter.

Balloon Sales Deflate

The Tektronix Phaser CP printer gives this graphic a snap of color. Colors were specified directly in PostScript code.

PC FACT FILE

**Tektronix Phaser Card
Tektronix Phaser CP**
Tektronix Inc.
P.O. Box 1000
Wilsonville, OR 97070
(503) 685-3565
List Price: Tektronix Phaser Card, $6,995; Tektronix Phaser CP, $6,000.
Requires: AT bus-compatible computer, PostScript- or HPGL-supported application software.
In Short: A high-quality PostScript-compatible color thermal wax transfer printer that runs off of an AT-bus adapter card.

CIRCLE **463** ON READER SERVICE CARD

NEW ON THE MARKET

Compaq's Advanced Graphics System: Hi-Res, High-Speed Graphics for CADD

The Compaq Advanced Graphics System, a graphics board and monitor combination, signals Compaq's entry into high-resolution graphics.

The $1,499 Compaq Advanced Graphics 1024 Board, populated with the standard 512K VRAM and 128K DRAM, generates 16 simultaneous colors at a resolution of 1,024 by 768; the optional $599 Compaq Advanced Graphics Memory Board adds 512K of VRAM for 256 on-screen color capability. A TI 34010 graphics processor helps speed performance to five times faster than 16-bit VGA, according to Compaq.

Application support includes display list drivers for AutoCAD Releases 9 and 10, and drivers for AutoShade, Au-

toSketch, and Microsoft Windows/286 and Windows/386. The board can be programmed to operate in either 8- or 16-bit mode and provides switchless configuration.

Topping off the system is the $1,999 Compaq Advanced Graphics Color Monitor, a 16-inch noninterlacing analog display. The monitor supports 256 colors at resolutions of 1,024 by 768 and 640 by 480, at a .29-millimeter dot pitch.

List Price: Compaq Advanced Graphics 1024 Board, $1,499; Compaq Advanced Graphics Color Monitor, $1,999; Compaq Advanced Graphics Memory Board, $599. Compaq Computer Corp., 20555 FM 149, P.O. Box 692000, Houston, TX 77269; (713) 370-0670.

CIRCLE 436 ON READER SERVICE CARD

The Compaq Advanced Graphics 1024 Board provides switchless configuration and support for 8- or 16-bit mode operation.

Impress Brings DTP Tools, WYSIWYG Display to 1-2-3

Even if your company is in the red, Impress helps you make the bottom line look a little better. PC Publishing's new $139 add-in for Lotus 1-2-3 gives you a WYSIWYG interface and several desktop-publishing tools.

Impress's features include eight different typefaces, eight shades of gray, and eight colors, as well as the ability to bold-face, shade, underline, and box.

Fonts, sizes, and styles can be set for individual cells, and you can print graphs and spreadsheets on the same page.

List Price: Impress, $139.
Requires: 384K RAM (hard disk recommended); Lotus 1-2-3, Release 2.0 or later, graphics driver for chosen printer; graphics adapter (for WYSIWYG display only); DOS 2.0 or later. Not copy protected. PC Publishing, 1801 Avenue of the Stars, Los Angeles, CA 90067; (213) 556-3630.

CIRCLE 440 ON READER SERVICE CARD

Intel Math Coprocessor Conserves Laptop Power

The privileged few who use the Compaq SLT/286, Toshiba 1600, and Zenith SupersPort/286 laptops can take advantage of Intel's 80C287A math coprocessor. The $510 chip needs one-third the power that previous models required,

according to Intel.

The 16-bit Intel 80C287A uses CHMOS technology to minimize power consumption and runs at 12.5 MHz.

List Price: Intel 80C287A, $510.
Requires: Compaq SLT/286, Toshiba 1600, or Zenith SupersPort/286. Intel Corp., PCEO, CO3-7, 5200 NE Elam Young Pkwy., Hillsboro, OR 97124; (503) 629-7354.

CIRCLE 438 ON READER SERVICE CARD

The Intel 80C287A math coprocessor uses CHMOS technology to minimize laptop energy requirements.

Borland's SideKick for OS/2 Presentation Manager

HOT PROSPECT

Borland, the company that gave us the first "gee-whiz" OS/2 application, Paradox OS/2, now follows it up with SideKick for Presentation Manager. The TSR desktop utility is available now bundled with IBM's OS/2. Borland says it will sell the product for $250, when demand warrants it.

SideKick for Presentation Manager uses the OS/2 graphical interface and clipboard for cutting, copying, and pasting data and graphics between applications, as well as displaying fonts, icons, and "child" windows. In addition to the multitasking capabilities afforded by OS/2, the program shares files with Paradox.

SideKick Plus will recognize the four applications of the Presentation Manager version: Time Planner, Notepad, Phonebook, and Calculator.

The Time Planner gives you monthly, weekly, and daily views of your schedule, with icons representing types of ap-

pointments. You can also attach notes to appointments or search for free time. The Phonebook features an auto-dialer and the ability to create multiple phone books. You can see your entries in table view or card view and import ASCII files.

You can save the Calculator's tapes for archiving or for rerunning similar calculations. The Notepad provides undo, search-and-replace, and the ability to integrate Calculator tapes into documents.

List Price: SideKick for Presentation Manager, free with IBM's OS/2.
Requires: 3MB RAM, 80286- or 80386-based system; EGA card (mouse recommended), hard disk, Hayes-compatible modem for dialing, the Presentation Manager, OS/2 Standard Edition 1.1 or later. Not copy protected. Borland International Inc., 1800 Green Hills Rd., P.O. Box 660001, Scotts Valley, CA 95066; (408) 438-8400.

CIRCLE 436 ON READER SERVICE CARD

NEW ON THE MARKET

PC Viewer Lets You Project Presentations Without a PC

In Focus Systems' PC Viewer is designed to lighten the burdens of presenters weary of hauling their once-lovable luggable or laptop: the projection panel's optional memory module provides 1MB of memory for storing presentations, allowing them to be run with or without a computer.

The panel comes in several models, all offering 640 by 480 resolution, eight shades of gray and eight patterns (user-selectable), and compatibility with the ISA bus, PS/2s, Apple IIs, and

Macintoshes. The $1,295 480S PC Viewer displays in bright blue and yellow; the $1,595 480GS PC Viewer projects black and white.

For an additional $1,400, a memory module and remote control combination upgrades both panels to the models 480S/2 and 480GS/2. The module contains firmware that allows you to add animation, dissolves, and other special effects to your presentations. The remote control provides an electronic pointer, underliner, and highlighter.

The PC Viewers weigh between 3 and 5 pounds, can endure temperatures of up to 149 degrees Fahrenheit, and can withstand a shock of 75g, according to In Focus.

List Price: 480S PC Viewer, $1,295; 480GS PC Viewer, $1,595; 480S/2 PC Viewer, $2,695; 480GS/2 PC Viewer, $2,995. In Focus Systems Inc., 7649 SW Mohawk St., Tualatin, OR 97062; (503) 692-4476.

CIRCLE 438 ON READER SERVICE CARD

In Focus Systems' PC Viewer projection panels feature bright blue and yellow or black-and-white displays

CheckFree Reduces Your Financial Paperwork

CheckFree Technologies hopes to lighten the burden of the personal check with Check-Free, a service that allows you to pay bills and transfer funds

income, expense, and budget reports; all payments are recorded automatically upon transmission. One added convenience is that, payments occurring at regular intervals can be processed automatically. For security, CheckFree encodes transmissions, and each account is pass-

CheckFree lets you automate repetitions and regularly scheduled payments

electronically, regardless of financial institution (all transactions are processed by the Federal Reserve system).

An initial charge of $29.95 gets the *CheckFree Servisware* software, documentation, and the first month's service; after that, the monthly charge for CheckFree is $9, with an additional fee after the first 20 transactions. The software provides a checking account register and

word-protected.

List Price: *CheckFree Servisware,* CheckFree startup package, user guide, and first month's service. $29.95: monthly service charge. $9.

Requires: 256K RAM, modem, DOS 2.1 or later. Copy protected. CheckFree Technologies. P.O. Box 897, Columbus, OH 43216; (614) 898-6000, (800) 882-5280.

CIRCLE 441 ON READER SERVICE CARD

AutoRead Confers Optical Character Recognition on the Multilingual Office

A novel newcomer in the recent spate of OCR software packages, AutoRead reads text in any language, even non-Roman-based alphabets like Hebrew and Russian. The $995 package—developed by Informatique Systemes TeleCom and marketed by Tutorland—learns characters, reads 100 characters per second, and has a recognition rate of over 99 percent, according to Tutorland.

The basic AutoRead package runs under Microsoft Windows.

The software reads typewritten fonts in sizes between 3 and 20 points, discriminates between similar characters (such as commas and apostrophes), and recognizes ligatures, split characters, and multiple fonts used on a single page. It features a text editor and zoom capability; files are output in ASCII format for importation into your word processor.

For an additional $1,000, the package includes Module 1, which allows it to handle italics, kerning, and proportionally

spaced fonts and read directly from scanners. For $3,495, AutoRead includes both Modules 1 and II. These two items let you define up to 99 windows per page, read columns, and omit graphics.

If you prefer to eschew the graphical interface, the $6,995 AutoRead Plus runs under DOS without Windows. It offers the capabilities of the other configurations but reads at over 200 cps and can read multiple fonts simultaneously, according to Tutorland.

List Price: AutoRead, $995: with Module I, $1,995; with Modules I and II, $3,495; AutoRead Plus, $6,995.

Requires: 512K RAM, Microsoft Windows (except for AutoRead Plus), 300-dpi scanner, mouse (hard disk recommended), DOS 2.0 or later. Copy protected in hardware (uses parallel port adapter). Tutorland Corp., 10850 N. Wolfe Rd., SW2-136, P.O. Box 160429, Cupertino, CA 95016; (408) 973-0472, (800) 888-8589

CIRCLE 437 ON READER SERVICE CARD

Asmflow Deciphers Assembly Code

PC HANDS ON

BY BARRY SIMON

Analyzing assembly language source code can be a nightmare. Even if the code is well documented, figuring out the logic can be daunting.

Fortunately, Quantum Software's *Asmflow* can help you. The $99.95 program will analyze your source code and produce a flow chart showing the logic of its procedures. The flow charts come with arrows, which show you where the code is jumping or looping. In addition, *Asmflow* will show you which procedures call other procedures. It will also indicate the number of CPU cycles taken by various parts of the code.

With code that's structured properly, *Asmflow* does a credible job. But when I gave it a piece of code that distinguished separate modules with comments instead of with formal proc/endp pairs, *Asmflow* sided with an error message. Because of its procedural orientation, jumps outside a procedure yield arrows ending in a question mark. An enhancement that will list target procedures and labels is in the works.

In the meantime, *Asmflow* still rates as invaluable for analyzing assembly source code. If you find yourself having to dabble with other programmers' assembly code—or trying to remember the logic of code you wrote months ago—this is one program you won't want to do without.

List Price: *Asmflow*, Version 1.24, $99.95. Requires: 384K RAM (640K RAM recommended), DOS 2.1 or later. Not copy protected. Quantum Software, 19855 Stevens Creek Blvd., #154, Cupertino, CA 95014; (408) 244-6826.

CIRCLE 431 ON READER SERVICE CARD

Two More Packages Push the Envelope

PC HANDS ON

BY EDWARD MENDELSON

Just after PC Magazine finished surveying six TSR envelope-printing programs for the Laser-Jet (see "Printing the Perfect Envelope," December 13, 1988), two more packages—*Addresseleye* and *Star*Lite*—arrived at the office. *Addresseleye* includes features that raise it above most of its rivals. The $89 *Star*Lite* costs a bit more but doesn't take up much RAM.

Barry A. Watzman's $46.95 *Addresseleye*, now in Version 2, has all the best features of comparable programs. It pops up over your word processor and captures an address from the screen. It lets you store up to ten return addresses and is easily customized for any standard envelope. You can select Laser-Jet fonts to make your envelopes more attractive, and the package's database feature automatically prints all the addresses in a file. You can even have the program print a promotional message in a box near the stamp.

What makes *Addresseleye* unique is that it demonstrates its author's recognition that printing a batch of envelopes at once is much easier than feeding each envelope separately every time you finish a letter. *Addresseleye* lets you capture up to 16 addresses and store them in RAM before printing all of them with a single command. The program supports the LaserJet envelope tray, so you don't even have to feed the envelopes by hand.

Addresseleye takes up 44K of RAM, supports all models of the LaserJet and compatibles, and can be used with any standard daisy-wheel or dot-matrix printer.

*Star*Lite* takes up less RAM—only 11K—but it's missing some features and introduces its own complications. However, a handful of worthy features justifies its high price.

*Star*Lite* lets you create nine different message lines like "Invoice enclosed" to print above the address. It has an option that prevents PrtSc from printing the screen. Expert users can adapt the program to send printer setup commands or even use it as a quick memo writer. And it can be modified to drive nonlaser printers if you know how to read printer manuals.

Unfortunately, *Star*Lite* assumes that you use the original LaserJet and makes you figure out where to print the address if you use the HP LaserJet Series II. If your return address is more than four lines long, you won't be able to print the last lines. *Star*Lite's "styles" allow some flexibility, but they're awkward to use—especially if you don't do all your work in the same directory.

*Star*Lite* may become more competitive, but only after it gets a much-needed upgrade. *Addresseleye*, on the other hand, leaves most of its competitors way behind through its full range of useful features.

List Price: *Addresseleye*, $46.95. Requires: 44K free RAM, DOS 2.0 or later. Not copy protected. Barry A. Watzman, 1206 Canteberry Ln., Mansfield, OH 44906; (419) 756-5295.

CIRCLE 433 ON READER SERVICE CARD

List Price: *Star*Lite*, $89. Requires: 11K free RAM, DOS 2.0 or later. Not copy protected. TSG Technical & Systems Group, P.O. Box 95, Streetsville, Mississauga, Ontario L5M 2B7, Canada; (416) 858-1885.

CIRCLE 434 ON READER SERVICE CARD

Utility Runs Any Program from dBASE

PC HANDS ON

BY LORI GRUNIN

If you can't break the 640K barrier, work around it: that's the idea behind Black & White International's *Switch-It*, a $40 utility that lets users run applications from within *dBASE III Plus* and compatibles when the "Program Too Big to Fit in Memory" message appears.

To run your favorite memory-hogging program without exiting *dBASE*, simply type RUN SWITCHIT PROG at the dot prompt, where PROG is the file that calls the program. *Switch-It* copies the current contents of memory to a temporary disk file and then loads the program. The temporary file resides in the root directory of either a hard disk or, for faster switching, a RAM disk. When you exit the application, *Switch-It* returns you to your *dBASE* session.

Switch-It also lets you create a menu of often-used applications. You define the menu parameters by creating an ASCII file with the three headings [menu], [message], and [command]—a functional if inelegant procedure. RUN SWITCHIT pops up the menu. If *Switch-It* doesn't find a menu file, it pops you out to DOS with the memory freed up.

A BIN-format version, included with *Switch-It*, allows you to use the software with LOAD and CALL statements in *dBASE* applications.

List Price: *Switch-It*, $39.95; *Switch-It Runtime*, $59.95. Requires: 15K RAM, DOS 2.0 or later. Not copy protected. Black & White International Inc., 23 W. 88 St., New York, NY 10024; (212) 787-6631.

CIRCLE 432 ON READER SERVICE CARD

CD-ROM Sourcedisc Lists Disk Titles, Includes Volumes of CD-ROM Reference

PC HANDS ON

BY EDWARD L. PERRATORE

There's no doubt that CD-ROM is a growing field. But for the best look at how it can help you, there's no better place than Diversified Data Resources' $89.95 *CD-ROM Sourcedisc*.

The product includes listings by name, subject, and publisher of more than 300 CD-ROM titles (plus interactive demos of some), reference works on the CD-ROM industry, and an extensive glossary of related terms. As an abbreviated version of the company's *CD-ROM Sourcebook*—the virtual bible of CD-ROM development and marketing—the disk is often included free with CD-ROM drives or software.

Sourcedisc offers three options for retrieving data; the first two, CD Titles and CD Info, let you browse the contents of each database on the disk. They also require no software installation other than the MS-DOS CD-

ROM extensions.

The third option, CD Source, may be your least frustrating route for a few reasons. To begin with, it uses *Microsoft Windows*; by contrast, CD Titles and CD Info lead you through a pair of inconsistent user interfaces developed by two different companies. Also, CD Source allows faster, more

flexible searching. Even here, however, there's one stumbling block to quick navigation: you must leave the *Windows* environment to switch databases.

A runtime version of *Windows* called *Personal Librarian* is included, but if you already use *Windows* 2.1 or later and have a mouse, you won't need it. If *Windows* is not your thing,

take heart—a command-line text database manager is available as well.

The *CD-ROM Sourcedisc* is hardly the most polished package available for this medium. A few bugs may hamper quick installation, and though on-line help is plentiful, printed documentation is sparse. But the *Sourcedisc* packs a wealth of information and should be well worth its price to anyone who owns a CD-ROM drive. ▣

CD Source, one of three ways to access data on Diversified Data Resources' CD-ROM Sourcedisc.

PC MAGAZINE

FACT FILE

CD-ROM Sourcedisc
Diversified Data Resources Inc.
6609 Rosecraft Pl.
Falls Church, VA 22043-1828
(703) 237-0682
List Price: $89.95
Requires: 640K RAM, IBM PC AT or compatible 286, hard disk with 1.5MB free, monochrome or color monitor with graphics adapter, compatible CD-ROM drive, MS-DOS CD-ROM extensions, DOS 3.1 or later.

CIRCLE 441 ON READER SERVICE CARD

DMI Portable Disk: Top Speed, at a Price

PC HANDS ON

BY M. DAVID STONE

If you like the idea of having a small, fast, easily detachable, external hard disk, you'll love the DMI microPORTABLE. Given its weight of 2.5 pounds and size of just 2 by 4 by 7 inches, microPORTABLE is an appropriate name.

DMI makes the drive in 20, 40, 70, and 104MB versions. All models are distributed by Harris Corp.'s Customer Support Division. For this review, DMI provided the 40MB drive (model DM370F).

The DMI drive is best understood as an external hard disk that happens to be portable. The 40MB package uses the ST506 controller that is probably already in your system. Installa-

tion is typical for external disk drives, from the first step of adding new cabling to your controller to the final steps of partitioning and formatting the disk.

The microPORTABLE's performance is a strong plus. On the PC Labs benchmark tests, the drive managed 22.26 milliseconds on the BIOS Disk Seek test, 27.66 ms. on the DOS Disk Access test, 18.08 seconds on the DOS File Access (large record) test, and 67.01 seconds on the DOS File Access (small record) test. This is faster in every case than the standard drive in the IBM PC AT. It is also faster than most other removable storage devices (see "Removable Mass Storage: You Can Take It with You," *PC Magazine*, September 13, 1988).

In addition to offering better

performance and higher capacity than the standard AT drive, the DMI microPORTABLE is well suited to applications in which data security is an issue. Turn the key lock located on the back of the unit, and no one can read from or write to the disk without a key. And of course, it is a trivial task to unplug the cable from the back of the drive if you want to lock your data in a safe each night.

It's worth noting that this is one of the few portable hard disk drives that automatically park and lock the heads when power is turned off. The manufacturer's shock rating of 40g is relatively low for removable drives, but it seems good enough. As one of the tests for this review, the drive survived several weeks of being toted between home and office.

PC MAGAZINE

FACT FILE

DMI microPORTABLE
Harris Corp.
Harris Customer Support Division
16001 Dallas Pkwy.
Dallas, TX 75241
(214) 386-2700
List Price: $1,995
Requires: Any computer equipped with an ST506 interface, DOS 2.0 or later.

CIRCLE 444 ON READER SERVICE CARD

The biggest drawback of the microPORTABLE is price. At $1,995 for each 40MB drive, the DMI unit is priced well above most of its competition. On the plus side, the list price includes on-site installation anywhere in the U.S. and 1 year of on-site service. ▣

PC UPDATE

Quant IX Provides On-Line Service

Quant IX Software is now shipping Version 3.1 of *Quant IX Portfolio Evaluator*, its investment software program. The updated package has a built-in Warner communications pro-

Quant IX Portfolio Evaluator 3.1 accesses a Warner communications program.

gram to provide an on-line financial service. Version 3.1 also handles fractional share amounts, sends reports to the screen for portfolio evaluation, and supplies communication script files. Upgrades are $45, and new packages retail for $89. Quant IX Software, Milwaukee, Wis.; (800) 247-6354.

EFax Adds Activity Log

Everex Systems has added a pop-up activity log to EFax, the software component for the EverFAX ED-12/48 fax modem. In addition to this KeyFax feature, EFax also supports .PCX and .IMG files and provides a "flip" ability, enabling you to view faxes upside down. Upgrades are free to all registered users. EverFax, which comes complete with the EFax software, retails for $495. Everex Systems Inc., Fremont, Calif.; (415) 498-1111.

Project Scheduler 4 Incorporates Inflation Factors

Scitor has added cost inflation factors and interactive resource leveling to its project management software, *Project Scheduler 4*. In addition, Version 1.5 includes multiple WBS (work breakdown structure) codes, alternative Gantt chart symbols, and a custom charactersize output option. Upgrades are $75, and new packages retail for $685. Scitor Corp., Foster City, Calif.; (415) 570-7700.

Watcom Introduces Remote Debugging

Watcom has added a remote debugging feature to its Watcom C Optimizing Compiler and Tools. Watcom C 7.0 also provides new runtime library functions and additional compiler options and pragmas. New optimization techniques include loop-invariant mode and very-busy-expression elimination. Upgrades are available to registered users for $75, and new packages retail for $495. Watcom Products Inc., Waterloo, Ontario, Canada; (519) 886-3700.

SlideWrite Plus Expands Font Support

SlideWrite Plus, from Advanced Graphics Software, has expanded its font support to include 16 software and 30 hardware fonts. Version 3.0 also supports scanned images and provides equation plotting, error bars, and 12 graph series. Upgrades are $50 to users who purchased *SlideWrite Plus* after July 1, 1988. All other upgrades are $95, and new packages retail for $445. Discounts are available with bulk purchases. Advanced Graphics Software Inc., Sunnyvale, Calif.; (408) 749-8620.

Microsoft's Quick C Uses Easy Menus

Microsoft's *Quick C* compiler now provides Microsoft QC Advisor, an on-line reference system, and Easy Menus for first-time users. Version 2.0 also offers incremental compilation and linking and a built-in, in-line assembler. Upgrades are available for $50, and new packages retail for $99. Microsoft Corp., Redmond, Wash.; (206) 882-8080.

Image Builder Creates Special Effects

Communications Dynamics has incorporated image export and special effects into its graphics presentation package, *Image Builder*. The special effects functions include Sweep and CurvedText, and the exporting feature allows
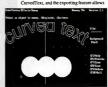

Image Builder 2.1 creates Sweep and CurvedText.

Image Builder to exchange files with other graphics programs. In addition, Version 2.1 provides an Alter/Template ability, hotkeys, and support for PostScript printers. Upgrades are $30, and new packages retail for $99. Communications Dynamics Inc., Tigard, Oreg.; (503) 684-5151.

The Brooklyn Bridge Goes Parallel

White Crane Systems has designed a parallel version for *The Brooklyn Bridge*, its file transfer utility. The parallel version is equipped with a 6-foot parallel cable, and it can transfer files between computers up to 15 feet apart. Registered users of the serial version may purchase the new parallel product for $45. Retail price is $139.95. White Crane Systems, Norcross, Ga.; (404) 394-3119.

COMMUNIQUÉS
by Bill Howard

We make a super VGA monitor.

that's also a SuperVGA monitor.

To promote its new MultiSync 2A extended VGA monitor, capable of 800 by 600 resolution (800 by 600 is also known as VGA Plus or Super VGA), the NEC ad contrasts a VGA resolution (top) with extended VGA resolution (bottom). A tiny, tiny footnote confesses: "VGA mode (at left) shown at 320 x 200." Most people call that mode CGA.

Amazing Facts I
"The [Zenith TurbosPort 80386] microprocessor runs at 12 megahertz and has a zero-wait state memory, so the computer need not wait for data to be saved."
—*Popular Science, December 1988*

Amazing Facts II
"A variety of different text resolutions are available with UltraVision: 80 by 34 pixels, 80 by 43.... The regular EGA text mode is 80 by 25 pixels.... The extended graphics modes (132 by 25 pixels and 132 by 43 pixels) are particularly useful for looking at large amounts of data on-screen."
—*PC Week, December 19, 1988*

Amazing Facts III
"[For sale:] TANDY 200 lap top portable computer—new! Compatible w/Mac. $500 xxx-xxxx.
—*Daily (Berkeley) Californian, December 12, 1988*

Desktop Computer Has Microprocessor
High-performance desktop com- and hard disk capacity to 320 Mb. It in-

Department of the Painfully Obvious, High Tech Division. (Best of NED column, New Equipment Digest, September 1988)

That Is Huge Indeed
"But IBM's engineers settled the contest [IBM Model 70 vs. Compaq Deskpro 386/25] when they reengineered Intel's 82385 cache-controller chip, doubling the size of the cache it can manage, from everyone else's 32MB to the Model 70's 64MB. That huge cache is a key to the Model 70-A21's speed."
—*PC Computing, January 1989*

A Computer You Can Truly Call a Clone
"Cole said the solutions do not involve a virus, a program that can order a computer to replicate itself. . . ."
—*Dallas Morning News, December 11, 1988*

In Their Own Little Ways, They Will
"In BYTE: . . . System reviews will include the Sun 386i and the Dell System 220. Both are 80386-based and in their own ways should be of interest.'"
—*BYTE, November 1988 (the Dell System 220 uses an 80286)*

Hints for Buyers
"Ask what type of keyboard is included. You need an IBM Enchanted Keyboard or equivalent."
—*Ontario Dentist magazine, December 1988*

Have you seen anything offbeat about the computer industry? Send submissions to Communiqués, PC Magazine, One Park Avenue, New York, NY 10016. Don't make marks on submissions. Contributors receive $50 and a PC Magazine T-shirt.

Winners for this issue: Jeff Crossley (PC has microprocessor), Wheeler Wood (loanshark), David Newsom (zero-wait-state), Mark Warner (80 by 34 pixels), Gary Fuller (Mac-compatible Tandy), Pankaj Shah (64MB cache), Gregory Silverman (enchanted keyboard), Fred Waggoner (computer replication), Nicholas Feakins (Dell System 220).

■ BILL MACHRONE

ARE USERS GETTING LEFT BEHIND?

Is technology advancing too quickly for the average user? If so, what problems can we anticipate, and what can we do about them?

Is the average personal-computer user getting left behind by technology? That's the question I was asked to address at a recent meeting of the Boston Computer Society's IBM PC User Group. On the rostrum with me were Dan Bricklin, author of *VisiCalc* and the eponymous *Demo Program*, and *PC Magazine*'s executive editors. The topic was a treat—a big, fat pitch that we could hit out of the park. It also provided a stunning display of accord among *PC Magazine*'s editors. If the Boston Computer Society had wanted a bloodbath, it should have asked, "What's the best laptop?" or "Why is your favorite word processing program the best?"

First off, let me say that I love rhetorical questions. It's a constant temptation in this column to set up straw men ("What is the meaning of life?") and knock them down ("Whatever I say it means"). Second, let me say that I'm going to indulge myself in this column and let fly with the rhetorical questions. Why? (There I go!) Because the questions in question are key to the continuing adoption of new technology.

NOT KEEPING UP? So, then, to the first question.

Is the average user getting left behind? The question, of course, leads to another question: By what or by whom? The "what," is, of course, the state of the art. It's the notion that the current crop of desktop computers are more powerful than what the average user needs. Asking "By whom?" implies a broadening gulf between the average user on one side and power users and developers on the other.

The idea that 386-based machines may embody more power than the user needs is especially pernicious. It's rooted in a lack of imagination, a conception that tomorrow's applications will be just like today's and that good enough is, well, good enough.

It isn't. Paul Somerson, *PC Magazine*'s editorial director, said, "I'd like to see the system watch what I'm doing—pick up on common errors, like the mistyping of commands, and correct them, or at least offer me some viable choices. I'd also like the system to notice when I do repetitive things and offer to show me shortcuts or make them into macros."

Paul said this at the meeting. He also said it 6 years ago, when we first started working on *PC Magazine*. And the idea isn't new, or even particularly daunting as a programming task. Do-what-I-meant, or DWIM, has been around since some of the earliest DEC machines. All it takes is processing power and memory, both of which are in short supply on your garden-variety AT clone, which forms the backbone of corporate computing.

The second notion—that power users and developers are leaving the user behind—is more problematic. Developers should rightly be ahead of the perceived needs of the user. As a result, of course, they will likely be condemned as being unrealistic. At the same time, they'll be accused of being years behind the hardware, and in fact they often are.

Power users come in two flavors, horizontal and vertical. The horizontally oriented users tend to live in infocenters and support a wide variety of software. Often they're acutely aware of the limitations of both the hardware and the software. They spoon-feed the users they support, telling them only as much as they need to know.

On the other side, vertically oriented power users are deep in one or perhaps two applications. They tend not to care so much about the hardware, except in its ability to run their favorite application faster. In both cases, there's a significant difference between them and the average user.

But any average user can become a power user. All it takes is time, research, and effort. The transition to power user is oftentimes subtle. It starts when someone asking you a question, just because you know something that he or she doesn't. One satisfied customer leads to another, and you suddenly discover what every educator knows: you learn more by teaching than you do by doing.

■ BILL MACHRONE

ANTICIPATION So what's the point of having the high-powered hardware before the software is ready? Because the software will never be ready—not all at once, anyway. There is no such thing as the unknown killer application, the new invention that will galvanize an entire generation of users into action. There are breakthroughs, to be sure. But progress comes incrementally, sometimes so slowly as to be nearly imperceptible. The only way to take advantage of the incremental improvements in software is with hardware that can run it. That means more memory, faster clock speeds, and more powerful processors. And, of course, there is a choice in processors—the 386 is the only one that gets you to the future.

Next question: Are today's users too slow in adopting new technology? You bet. Corporate America is incredibly hidebound. I can understand the reluctance to leave behind embedded standards such as *Lotus 1-2-3* and *dBASE III*. Our surveys have shown that software has to be perceived as at least twice as good before most organizations will undergo the replacement and training costs. That, however, doesn't explain the widespread unwillingness to try new technology.

Just think how many people could benefit from a personal information manager, be it *Agenda*, *PackRat*, or *GrandView*. Do you know how much time you could save with a topflight dialer, such as *Hot Line II*? For that matter, isn't it time to take a serious look at text databases? *IZE*, *askSam*, and others are bursting with capability, just waiting to organize your data.

Finally, there's the new category of disk and work organizers, led by Lotus's *Magellan* and Traveling Software's *ViewLink*. Anyone who's ever misplaced a file on a hard disk needs *Magellan*, which can search for text through almost any type of file, whether it's a spreadsheet, database, or program file. Anyone who uses two or more application packages in their daily work could benefit from *ViewLink*, a package that establishes links between files based on subject matter, regardless of their parent applications. But will any of these products get a fair hearing from you, or from your organization?

It's entirely too easy to be satisfied with the status quo.

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■ JOHN C. DVORAK

CRAZY MISTAKES, PART 1

From tales of copying "star dot star" to stapling floppy disks, Dvorak's heard 'em all. But if you can top these funny anecdotes, he'll have material for Part 2.

Once in a while, we have to look at this industry and ask ourselves if its growth is hampered by the lack of computer literacy. The indicator is the crazy stories you hear from the people in customer support. Many mistakes stem from simple misunderstandings, some from illogical assumptions. Most are caused by either ignorance or stupidity.

I've collected some of the funniest anecdotes and encourage you, dear reader, to send me other examples.

The most-told story is about the guy who literally tears the floppy from the sleeve and complains about the difficulty he has inserting it into the drive. I'm sure it happens. But how about a story I gathered from 47th Street Photo executive Bobby Orbach:

A guy calls the support line complaining that his disk drive won't read the disk. He says he followed the instructions in the manual to the letter. "I inserted the disk into the drive. It said insert the disk into the drive, okay? Then I got up and closed the door to the office. I said close the door."

Another common mistake occurs when telling someone to copy a disk by typing "COPY *.*" and hitting Return. It looks good in print, but over the phone the tech support guy says what they always say: "Type copy star dot star and hit Return." The user then types "star dot star" and gets nowhere.

Brian Roemelle at Ariel Corp. told me that some fellow couldn't figure out why he was having so much trouble running programs on his hard disk. Apparently he, too, had taken instructions too literally. He created a subdirectory named "root," which he used as his root directory (get it?) and a subdirectory called "subdirectory" for all files that belonged in a subdirectory.

From Vadim Yasinovsky, honcho at Clear Software, I got the story about the unnamed New York computer guru/consultant who couldn't figure out why none of his complex database programs would run right. Someone looked at his disk, and it turned out he had all the files of all his numerous programs in the root directory, causing all sorts of conflicts.

"Why don't you put these things in subdirectories?" someone inquired. The guru, somewhat irked, told him bluntly: "My hard disk didn't come with that option!"

Then we have the story about the person who, when confronted by the message "Click mouse button here," put the mouse up to the screen and clicked it there. Sheesh!

It somehow reminds me of a scene from the movie *Star Trek IV*. When Scotty—flung back in time—gets confronted by a Macintosh, he picks up the mouse and talks into it! People at Apple report that many first-time users wave the mouse in the air, expecting something magical to happen.

Yasinovsky also told me about the time he told a customer to send him a copy of a disk. The next day he received a photocopy of the disk!

Among the other stories that abound is the one about the computerist who uses a magnet to hold the disk against his computer and wonders why he has problems. Then there's the woman who sent a defective disk back to the vendor. The note explaining the problem was stapled to the disk.

More-common mistakes, like accidentally copying an old COMMAND.COM file to your hard disk from a floppy, can happen to anyone. The result is usually disastrous.

Some people can't figure out why a daisy wheel printer can't do dot matrix graphics. People see error messages such as "IF-END STATEMENT MISSING." Then they complain to the vendor of the interpreter asking, "On what line?"

You have to wonder if our ability as humans to communicate has peaked and is now going downhill to the point that one will have to show, step by step, how to do anything. Useful written instructions are rare. If you have any anecdotes like these, send them to me and I'll get you a genuine Dvorak pocket protector.

■ JOHN C. DVORAK

INSIDE TRACK

Watch out for Big Blue's Big Bang

None of it surprises me. A 2,000-page report from International Technology Group (Los Altos, Calif.), entitled *IBM Directions*, says that the main goal of IBM through 1996 is to stem the trend toward standalone computing. The entire MCA strategy, says author Brian Jeffery, is to create a fancy environment of clustered coprocessing workstations running off a host. The heck with one computer/one person. Look at what Metaphor is doing and you'll get some idea of the new IBM approach to small systems. Look for a complete change in the product line scheduled for 1991–92. According to its $7,500 report, the new line is code-named the "Big Bang." Think about the reference and you'll see IBM's hidden agenda. Until then, IBM will subtly revamp the product line every 12 months. Call ITG at (415) 941-2433 for information on how to get the report.

With the sudden departures of King, Maples, Lyons, and Lowe from Entry Systems, followed by the installation of a new ESD boss from the mainframe side of the company, it's obvious that the good old days are over. (Didn't the old-time IBM watchers tell us to expect this!?) In the near term, Model 30s will continue to be sold and things will look unchanged. Long term, IBM's role as a leader in the industry, if it is to continue, will be oriented toward de-emphasizing the powerful single-user system. The fact is, the powerful single-user system is getting too powerful too fast!

This brings me to a rumor I heard twice in the last week: IBM is expected to consolidate the PS/2 series of machines. I was told to watch for the disappearance of the Model 60, 70, and 80 in favor of a new Model 90 and a yet-to-be-announced Model 100. Apparently the 50 and 30 will remain in some form or other. At first I shook my head; then I thought about it. Did I know anyone who has ever bought a Model 60, for example? No. Everyone talks about the Models 70 and 80, but who uses them? I know of plenty of 30s and 50s around. I concluded that this conjecture is a possibility. I mentioned it to Brian Jeffery and he thought it was hogwash. We'll see.
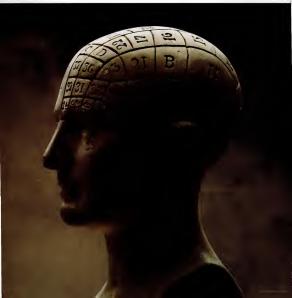
Whatever the case, we're in a ship without a rudder, and we haven't been told because the captain already jumped over the side. If IBM isn't going to provide direction (other than hear a path back to its mainframes), then who is? Since the introduction of the PC in 1981, the hardware makers have conceded the leadership role to IBM, and no real attempt to achieve a new direction was ever mounted. Now all we have are legions of sheepish followers who keep staring, bug-eyed and catlike, at IBM, hoping for a sign. "What do we do next, Jeb?" Answer: Pray for rain. No wonder users are flocking toward the Macintosh.

If It Walks Like a Duck Dept.: I've had it with the new copy protection scheme. Especially when the disk says "Not copy protected." What I'm referring to are packages that have a key code that needs to be entered during program execution or during installation. Folks, this concept is more irritating than physical copy protection schemes! Lose the sheet with the codes and you may as well toss the package. Since documentation is the first thing that gets tossed or lost, vendors who use this technique are flirting with trouble. Game makers, in particular, should find another solution. *Scavengers of the Mutant World,* for example, tells you to look up words in the documentation. Half the time, the unclear directions to find the words fail. So you enter the wrong word; you're called a pirate by the game and then have to go through an elaborate restart. I tossed the game in the trash. Then I ran into a company with a menu program (of all things!) that used the same technique, and I couldn't get the thing to install because of the code. This concept is a bad idea, and users should reject it.

Genuinely Interesting Software Dept.: Here's one of those nicely done packages that you see once in a blue moon. Grad student Bob Simmons spent 3 years developing three inexpensive but quite elaborate systems: *CoPlot,* a scientific graphics package; *CoDraw,* an excellent technical drawing package; and *CoStat,* a superb statistics package. If you're in the market for some slick scientific/engineering software, then get these systems. This is perfect software to create those scientific drawings and graphs for that thesis you haven't finished! Also, if you are a developer who wants to see a superb use of the mouse on a PC, then you should check out this stuff. Each package is $99, and Simmons will sell all three for $249. Don't let the low price fool you; this is excellent software. Write to Cohort Software, P.O. Box 1149, Berkeley, CA 94701, or call Simmons at (415) 524-9878.

More Genuinely Interesting Software Dept.: For over a year, I've been meaning to say something nice about *Lattice Secret Disk II* ($79.95 from Lattice Software, 2500 S. Highland Ave., Lombard, IL 60148; phone (312) 916-1600 or (800) 533-3577). I've been waiting to get that Round Tuit in the mail (joke alert!). This package is an exquisite way to create encrypted and secure files. It creates a virtual disk on a hard or floppy disk; the virtual disk appears when the program and password are executed. Very elegant. Highly recommended. By the way, look for Lattice to roll out a killer version of their once-dominant C compiler in the months ahead.

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■ JIM SEYMOUR

A GUIDE TO PIMs, PART 2

To satisfy your personal information management needs, try a two-tiered approach: GrandView for structured data and MemoryMate for spontaneous, unpredictable notes.

In the last issue, I wrote about my personal experience wandering through the software jungle of PIMs, or personal information managers. I find PIMs the most useful new category of PC software to have come along in 2 or 3 years. And yet for many users—myself included—the hype that has accompanied their introduction has often obscured their value and made choosing the right product more, not less, difficult.

The result for me—just as for many of those I work with—is that I wound up refusing to make a single choice. Instead, I've settled on two PIMs for my own work.

That's because my needs are divided into two areas. The first consists of relatively structured data—but when I say structured, I mean in form only, not content. The second is spontaneous and unstructured, unpredictable in form as well as content—"interrupt-driven," to use a computer-business cliche.

ORGANIZING ORDERED DATA For the first category, the relatively structured work, I chose Symantec's *GrandView*. If I had to use only one PIM, it would be *GrandView;* indeed, if I had to choose just three or four programs for all my work on the PC, *GrandView* would be on my list. It's that good.

It's easier to understand how I use *GrandView* if I cast an apparent slur on it: it's a glorified outliner. If you're outline-phobic, scarred forever by bad experiences with Mrs. Smerdly in seventh-grade English, you're not likely to think that's much of a compliment. I find outlining

programs—such as *GrandView*'s spiritual ancestor, *ThinkTank*—enormously powerful and useful. But never half so powerful and useful as I've found *GrandView*.

How do I use it for "structured" information?

Example 1: I help run an organization with many employees, all of whom get regular performance evaluations. Even though only a small number of them report directly to me, I am involved in the evaluations and salary reviews of about 50 people through a secondary-review process.

That means I need a way of keeping notes on what I observe about the performance of those 50-odd people. I use a *GrandView* outline, which has a first-level entry for each person's name. Under that entry I add quick notes. Each note begins with the date and is added to the end of that person's section, so my notes are automatically in chronological order.

For scheduled evaluations and for those

more-frequent, informal, sit-down-and-let's-chat sessions, I open and print out the entries for the person I'll be meeting with. Thus, I have all my recent notes on that person's performance at hand.

I used to use a huge deck of index cards, which was enough to drive me nearly crazy . . . with the inevitable effect that I made fewer notes, at longer intervals, than I should have. Now it's so quick and easy that I stash notes almost every day; some days, I add a dozen notes to the file.

Example 2: Every meeting needs an agenda; almost every meeting needs a follow-up memo on what was agreed upon. But few of us have the time to *save* time by drawing up and distributing those agendas, let alone sending out summaries of "action items" afterwards.

I use *GrandView* to knock out fast agendas. Its support for the typeset-look fonts I like to use with LaserJets makes those printed agendas neat and crisp. During meetings, I annotate the printed agendas by hand. Then I fold the annotations into the *GrandView* outline on the computer, reprint it, and send it out again in its expanded form to the participants.

Yes, when I'm really busy, I have someone else do the middle and last parts of that work—taking notes at the meeting and folding those notes into the *GrandView* outline for the printed follow-up. But the whole process is so quick and direct that I usually do it all myself.

I use *GrandView* in many other ways as well, but these examples show how powerful it can be, and how useful it has become to me.

■ JIM SEYMOUR

THE PRINCE OF POP-UPS The second PIM I've adopted is Broderbund Software's *MemoryMate,* which I use for quick pop-up notes in the second, utterly *unstructured* category of my work.

If *GrandView* seems to me the Rolls-Royce of PIMs, *MemoryMate* is the Volkswagen: it's cheap, reliable, and utterly functional.

It takes only about 90 kilobytes of RAM. And if you've got some LIM EMS 4.0 memory available in your machine, as I do, it takes only about a third of that amount. I think both figures are reasonable prices to pay for *MemoryMate*'s considerable pop-up functionality.

I use it constantly for quick notes when I'm on the phone, or just after someone's left my office when I want to capture the essence of their ideas and our talk. I can get about four screenfuls of information into a single *MemoryMate* note (though I never knew how long its notes could be till I did some testing for this column: I use *MemoryMate* for short notes).

In fact, I use only a fraction of *Memory-Mate*'s capabilities. I like its ability to construct a tickler file and add items to it, but I don't use its hypertext linking or screen-form generation. And there are probably lots of other features I've never discovered.

> ■ If *GrandView* seems to me the Rolls-Royce of PIMs, *MemoryMate* is the Volkswagen: it's cheap, reliable, and utterly functional. I use it constantly.

MemoryMate lets me retrieve information quickly with easy searches, and it lets me do a second search if my criteria were too sloppy the first time and I got too many hits.

Those two PIMs handle everything I need from a computerized personal-information-management system. I couldn't do such work nearly so well with any *one* PIM on the market. And having gotten used to how well these two tools work together, I can't imagine doing without either one.

I hope your journey through the PIM jungle is equally rewarding—and that these two columns have helped you focus your search more effectively.

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Before you buy a printer, get a second opinion.

■ **WILLIAM F. ZACHMANN**

MUSIC IS THE BEST

The importance of music in the world of computers and business is as yet unsuspected. In the future, though, it could create new and exciting ways to analyze and interpret information.

In the piece entitled "Packard Goose" from Frank Zappa's rock opera, *Joe's Garage*, a young woman identifying herself as "the girl from the bus" says simply: "Information is not knowledge. Knowledge is not wisdom. Wisdom is not truth. Truth is not beauty. Beauty is not love. Love is not music. Music is the *best!*" While that notion may seem extreme, music may have a significant role to play in the world of computers and business before long.

The point where music and computers meet is called MIDI (Musical Instrument Digital Interface). Developed by synthesizer manufacturers, MIDI is a standard hardware-and-software interface for connecting computers to sound-producing electronic components and performance instruments. MIDI stems from the background of musical performance and recording; it effectively standardized what was previously a diverse and incompatible collection of electronic synthesizers and related components. It is a key element in the shift from analog toward digital sound production, recording, and reproduction techniques that is revolutionizing the recording, movie, and entertainment industries.

THERE'LL BE CHANGES MADE A fact not yet much appreciated, however, is that, with continued advances in related technologies, MIDI will have important applications in business. It is one of a number of related digital technologies that will eventually open the door to a spectacular range of new applications for computers.

The most immediately accessible of these may prove to be in the area of desktop presentation systems. Still in its infancy, desktop presentation uses a PC, typically with a large high-resolution screen, as an alternative to the flip charts, overhead transparencies, or 35mm slides typically used in sales and projects presentations, reports to management, educational institutions, and so forth. As desktop presentation technology matures, it is virtually certain that these older methods of presenting information will be replaced by computer-based alternatives.

The MIDI interface, combined with increasingly powerful yet inexpensive sound-generation modules (or synthesizers, as they are more typically called) make it possible to add sound and music to these presentations. Using prerecorded music of the sort that typically accompanies the expensive, multiprojector, multimedia corporate-image slide shows that have become an essential corporate ritual—at least in the United States—MIDI offers the ability to dynamically, even interactively, manipulate the music program.

ALL THAT JAZZ With MIDI, the computer controller "plays" the sound synthesizer. Unlike in a conventional analog recording, such as a vinyl record or a magnetic tape or cassette—or even a modern digital record, such a compact disk player or digital audio tape (DAT) recording—the signals sent over the MIDI interface actually tell the electronic "instrument" what notes to play and how loud and how long to play them.

The sequence and combination of sounds generated by information passed over the MIDI interface can therefore be manipulated in real time by the controlling computer. Combined with a sophisticated synthesizer, it can not only reproduce the sounds of a jazz combo or a symphony orchestra but can also create a variety of sounds that no real instrument is capable of producing.

Assuming that current trends in design and performance continue, in only a few years a salesperson calling on a customer in his or her own office may, with the aid of a portable computer and synthesizer, give a presentation about the company and its products that can be accompanied by sound and music.

ACCENTUATE THE POSITIVE A more exotic but possibly even more valuable music application may be found in the

■ **WILLIAM F. ZACHMANN**

areas of training and motivation.

It was not by accident that ancient Buddhist texts claimed that enlightenment comes by way of the ear. Sound has a motivational and emotional impact on people that is far more immediate than visual stimuli. Just think about the role that a musical sound track plays in setting the emotional tone of a film. In the future, when MIDI is combined with voice synthesis, it

will serve as a powerful stimulus and feedback mechanism that will harness the motivational power of sound in learning situations.

SOUND ADVICE Another idea that may sound even more speculative could prove to be the most valuable one of all—the development of ways to represent information as sound! Just as the transposition of rows and columns of numbers into a visual representation as a graph or scatter diagram may make it much easier to discern the underlying pattern of the data, so the transposition of information into sound may turn out to be similarly useful for expressing numerical data.

Crazy as that may seem, it has already been done—with quite interesting results. Darryl Gammil, of Gammil Records in Denver, Colorado, has produced sound tapes where key technical variables such as daily stock price and volume, insider buying and selling, achievement of new highs and lows, and intersection with 50-day moving averages are translated into musical sounds. The pattern of the data literally "plays" the synthesizer. Price and volume controls the melody and intensity of the piece, for example, while a new 13-month high or low generates a cymbals crash.

Interesting as Gammil's tapes are, they are no more than early explorations in representing information in sound. What's more, they are as yet available only in a prerecorded form.

INTERACTIVE AUDIO In time, MIDI will make it possible for anyone who wishes to do so to experiment with creating audio and visual representations of complex data and to do so interactively, trying out different combinations of data series and sound to find those that best exhibit the essential pattern of the information.

Whether or not any of this has anything to do with knowledge, wisdom, truth, beauty, or love is beyond me. That computer-generated music via MIDI may open the door to some remarkably practical and useful ways of analyzing and interpreting information in business, however, is far more likely than anybody at present suspects. Walking through that door may offer an unexpected competitive advantage to those who can find it.

■ STEPHEN MANES

LEARNING FROM A MOVING EXPERIENCE

Haunted computers, decorator toner, errant jumpers, bouncing screws, puzzling switches—they're all part of Manes's eventful cross-country move.

Moving across the country turns out to be a lot like developing software. Both processes induce obsessive behavior, take control of your life, and are impossible to do without major bugs. As I stare across the Monument Valley of Cardboard and contemplate the Mountain of Shelfless Clothing, I take a moment to reflect on what I've learned from it all that has anything whatsoever to do with computers. Quite a bit, it turns out:

Paint it black? With great decisiveness, I determined to cut my moving bill by shipping my star-crossed Okidata LaserLine 6 laser back to the factory. I followed the repacking instructions in the letter; hey, I had done it once already for the machine's earlier amputation.

And somehow I spilled toner all over the carpet again. The carpet was doomed to the anyhow, but this was the last straw in a long history of toner woes. At that moment I vowed never to buy, use, or even approach another machine with a separate toner cartridge. The all-in-one expendables may cost slightly more in the long run, but at least they won't turn your toes black.

Does the Knowledge Navigator point to the storage area? The fellow who packed my dishware, glasses and computer equipment was singularly unimpressed when he got around to wrapping up my trusty old PC. "A PC, huh?" he said contemptuously. "I got my kid a Macintosh."

"What does he do with it?" I inquired.

"Nothing. He got bored with it. It's in the closet."

Is my laptop haunted? Part 1. While awaiting the advent of a truly lightweight DOS machine that offers some sort of writable medium, I lug around an old Toshiba 1100 Plus that I've come to love. With my desktop machine barreling along somewhere on an interstate highway, I not only love but depend on the 1100 a lot. And therefore didn't bother paying my usual attention to the low-battery light, which tends to come on too early anyway.

One final save before recharging. Oops! The juice is too low to run the disk drives! I really should have believed that warning light. But I didn't expect the machine to reboot itself—or try to. Since it couldn't read the boot disk, it simply went through its memory test, gave up, and tried again. And again. And again. Weird.

Save your original packing materials? When you live in a New York apartment, finding a place to stash a huge carton is about as easy as finding your building superintendent when the pipes break. I had retained the original box for only the

newest of the three monitors I own. It turned out to be the only carton in the entire shipment that displayed exterior damage—a seriously crushed corner. The monitor was fine, though. At least from the outside; I'm still working on digging up my color video card.

Why the Micro Channel? The guy who packed my PC did a competent job, but when I unwrapped the thing, it made a rather faint rattling sound. Further investigation revealed the noisemaker to be a single plastic jumper sliding around on the motherboard.

First reaction: sheer panic. There are any number of jumpers on the cards in my machine. There's absolutely no way to figure out the proper settings without spending half an hour with each manual—assuming I can find the manual, and assuming the manual is right.

Second reaction: pure hope. A more logical analysis suggested that the chances were good that the Wandering Jumper hadn't been doing anything much anyway. Chances were pretty good that since I had fallen off, it had probably been sitting on a single pin, rather than two, and was therefore nonfunctional. All I'd have to do would be to boot up and find out.

So I grabbed my trusty screwdriver and removed the screw covering the slot where my HardCard should go. The slot-cover screw fell down into the machine and hid itself under a bunch of cables.

With a Micro Channel machine, of course, none of this ever would have happened. Micro Channel cards aren't supposed to have jumpers; they even plug in

■ **STEPHEN MANES**

without screws. Maybe the missing-jumper/missing-screw problem will be part of the EISA Diagnostic Olympics.

Whatever happened to backup? As I hoisted the errant jumper and screw from the machine, I began to seriously worry whether my HardCard, which had been shipped in its original box, would work. It's supposed to be able to handle shocks of up to 100g, and I'd seen the way some of the moving crew had handled some of the lighter packages. But of course, you say, didn't I have all the data on the hard disk securely backed up?

Flog me. Beat me. Lock me up. The sad truth is that I had *some* of the disk backed up—doably, and for most of the important stuff, triply. But the process took so darned long that I finally gave up and decided not to back up any applications at all. After all, I had the master disks around somewhere.

Admittedly, that was kind of stupid.

Most of the apps I use have been customized in one fashion or another; if there were a problem, I'd have to rejigger them from scratch. So I handled the HardCard with exquisite care as I installed it in its customary slot.

Then I booted the machine. I don't know why, but the fan made a slow, chugging noise—sort of "I think I can, I think I can." Then it began to sound like a washing machine with a very unbalanced load. After an eternity, it put the cursor on my screen. CONFIG.SYS and AUTO-EXEC.BAT did their things. I knew at that moment that I was home free. Unless that missing jumper controlled some obscure interrupt.

Is my laptop haunted? Part 2. That night I stepped into my new office and heard an annoying, high-pitched whine that was incredibly hard to localize. My answering machine is highly prone to feedback—was that it? I unplugged the thing.

Nope. How about the stereo? Nope. The monitor? I scrambled up the stairs and down. It wasn't the burglar alarm. Or the garage-door opener. Or the heater. Was the place haunted?

No, but the laptop was down so low again because I'd folded it up without bothering to turn it off. It normally sends out a beep for a few seconds when you shut the lid. For some peculiar reason, it was now whining incessantly—or at least until the battery would be unable to do even that. Go figure.

You can run it, but can you hide it? Rule number one in ads for computers and stereo equipment: Never show the cables. In the real world? When I get around to it, I'll doubtless spend a significant amount of time and money on concealment; meantime, my workspace looks like a convention of eels.

Now where are those modem cables, so I can send this in?

Your networking plans don't necessarily have to include high-priced equipment and dedicated servers. Here's a look at 11 systems that offer data sharing for an average of $350 per workstation—and allow do-it-yourself installation.

BUILDING WORKGROUP SOLUTIONS

LOW-COST LANS

PC *Magazine*'s LAN Labs gets more letters asking about simple ways to share disk files and printers among several users than it does on any other single subject. The choices are many and vary widely: from simple zero-slot LANs, which use the PC's existing serial ports for sharing data, to high-end LAN products like Banyan's *VINES*. Your first step,

then, is to determine what you need today—and predict how much expansion you'll need in the days ahead.

Installing a local area network, however, need not demand high-end equipment and pricing. If your involvement must remain limited to the best network you can get without heavy expense, take a look at low-cost LANs as an alternative for data

sharing.

sharing. These systems offer a full capability for exchanging files, sharing printers, and allowing multiple stations to have simultaneous access to the same data files.

Products reviewed in the pages that follow cost an average of $350 per user (based on a four- to six-user system) for the operating system, adapter cards, and cabling. Among these systems are also the higher-cost Novell *ELS* (for *Entry Level Solution*) *NetWare II* and the TOPS network, which are intended to serve as familiar benchmark entries from well-known vendors. The cost of installing some products, like *NetWare* and Western Digital's *ViaNet*, can vary by as much as $200 per node depending on what kind of network adapter cards you choose. But this price variation doesn't necessarily correlate with performance: some of the least expensive cards available in the market, for instance, use the ARCnet protocols. And ARCnet is known for its fast and steady performance.

ONE LAN AMONG MANY Low-cost LANs are only one of many data-sharing alternatives, which generally increase in complexity and price as they increase in capability. Here's a look at what's out there.

ZERO-SLOT LANS About 3 years ago I reviewed the early RS-232C data-sharing packages in *PC Magazine* and dubbed them "zero-slot LANs" (see "Zero-Slot LANs: A Low-Cost Solution," *PC Magazine*, November 26, 1985). These packages let a few users share resources among themselves using the existing serial ports in their PCs. The only drawbacks to the systems were their slow speeds and the hair-pulling that is sometimes needed to get the cables properly arranged.

Zero-slot LANs are primarily useful for transferring files, although some of them can do a good job of sharing printers as well. From products like Traveling Software's *Lap-Link Plus* have come new innovations in this field in the way of menu-driven interfaces. Another product, *LANLink*, Version 5, from The Software Link, uses the parallel ports of the machines to move data faster. *EasyLAN* from Server Technology is a leading product in this category; a two-node kit including cable sells for $219.

DATA SWITCHES Data switches, the next more sophisticated alternative for data sharing, also use RS-232C wiring. But because they carry out security processes and data-switching jobs in a separate box outside the PC, they don't load down the PC's processing power as much as zero-slot LANs do. Making connections through a data switch is like using the telephone. The switch connects the ports of any two devices on request until the connection is dropped by either side. Data switches are

> Low-cost LANs allow
> any workstation on the
> network to make files and
> printers available to other
> users—with no dedicated
> server.

handy way to integrate Macintosh computers, laptops, minicomputers, and PCs to share printers, modems, and files.

As the cost of real media-sharing LANs declines, so does the appeal of RS-232C-based zero-slot LANs. Data switches, however, may lose little appeal because of their simplicity and ability to integrate dissimilar machines.

Rose Electronics, Itron, NewBridge, Digital Products, BayTech, and Equinox all make excellent data switch products for the PC. Costs for these products can be as low as $100 per port, and they should be carefully considered by anyone shopping for a way to link PCs and other devices.

When you look for sharing alternatives that are more flexible than data switches, you typically pay a significantly greater price per node and incur a similar rise in complexity. But all of the alternatives above data switches share one important feature: they give PC applications multiple simultaneous access to the same files.

MULTIUSER OPERATING SYSTEMS Topping data switches in terms of capability, speed, and complexity is an alternative called multiuser operating systems. An old

concept benefiting from new technology, today's multiuser operating systems take advantage of the high power of the 386 processor. They typically allow two to seven people using inexpensive RS-232C terminals to run DOS application programs on the same 80386-based computer at the same time.

These multiuser systems run all of the popular DOS applications and make an excellent alternative to equipping new users with their own PC. Their one drawback at present is the lack of file security. Any user at any terminal can typically get to any file on the host machine. In many applications this works just fine, but many people will certainly feel the need for privacy, if not real security.

The 386 machine needed to run these operating systems will have a list price of at least $6,000. For terminals add $300 per workstation, and the multiuser software costs about $800. This gives a five-user system a price of about $1,660 per node, but that includes the equivalent of a PC, a monitor, a LAN interface card, and a server for each user.

Leading products in the multiuser operating system arena include Alloy Computer Product's *386 Multiware*, The Software Link's *PC-MOS/386*, Digital Research's *Concurrent DOS 386*, IGC's *VM/386*, and Virtual Systems' *QuickConnect*. *PC Magazine* reviewed some of these systems in the February 28, 1989 issue and will review other systems in the near future.

LOW-COST LANS Topping multiuser operating systems in performance and price are the low-cost, DOS-based LANs reviewed here. These products ordinarily use DOS as the basis of their server filing system—as opposed to products like *NetWare*, *Nexos*, and *3+Open LAN Manager*, which use proprietary operating systems (or, in the case of *3+Open*, OS/2). They also allow any node on the network to make files and devices like printers available to anyone using the network—without the need for a dedicated server. And the number of nodes per system varies depending upon your applications.

There are nearly a dozen alternative LAN products in this category, ranging in price from $300 to $600 per node; the most

expensive system included in this review is POWERlan at nearly $500 per node. Products reviewed are CBIS's Network-OS (with value-added versions from Performance Technology and Datapoint), DNA Networks' DNA Networks, Artisoft's LANtastic, TOPS' TOPS/DOS, Corvus Systems' PC/NOS, Western Digital's ViaNet, Novell's ELS NetWare II, Localnet's LANsmart, and Invisible Software's Net30. When a company did not offer a package price for a specified number of nodes (for six users, for example), we calculated the product's per-node prices on the price per adapter card with cabling plus a share of the total cost of the operating system's site license.

HIGH-END LAN PRODUCTS. Above the 386-based multi-user systems in performance, flexibility, and cost are the high-end LAN products based on OS/2 or other non-DOS operating systems. Novell's NetWare, Banyan's VINES, 3+Open LAN Manager, and DSC's Nexos are all major players in this market.

At prices in the neighborhood of $2,500 per node for the same four to six nodes (cabling excluded), these operating systems give much better performance than the DOS-based alternatives, but they require the server to be a dedicated machine. They can operate over a variety of network interface cards, and they contain features like accounting and troubleshooting utilities, as well as offering improved security options. In addition, these systems include standard protocols and services that let sophisticated programs communicate with one another.

Each of these ways of linking PCs has benefits and drawbacks. Often, installing a system like a data switch can be the total solution for an organization's computing needs. But computing needs always grow, and the ability to migrate to the most powerful alternatives is an important consideration.

CLOSER LOOK AT LOW-COST With the exception of Novell's ELS NetWare II, these LANs use DOS-based file servers. The DOS-based networks allow any station to act as a server and to make available to other stations resources like drives and printers. All of these networks, including

NetWare, let the server act as a DOS workstation while performing its server duties. Some will let a workstation act as a server as well.
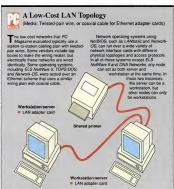
While installing these networks generally isn't a complex job, it does require attention to detail and a strong understanding of DOS. The typical installation steps include copying the networking software to a subdirectory on any machine acting as a server, installing the network interface cards, connecting the wiring, and arranging for the sharing of resources.

This sounds straightforward and usually is. But many small details, from conflicts among pieces of hardware using the same interrupts to improper installation of a cable-terminating resistor, can prevent the network from operating. Whenever you apply a significant modification to the basic operating system of a computer—and that is what networking software

is—you run the risk of conflict.

There's also a price to pay in RAM dedicated to network tasks, in both workstations and the server. Simple client workstations that don't contribute resources to the network can lose up to 130K of RAM to the redirector and the enlarged buffers used to handle the input/output tasks of the network. Machines that act as servers on the network can lose more than 300K to the networking software—all depending on the software you're using. Some packages, like LANtastic, have much smaller RAM requirements than the others.

The majority of these low-cost LAN systems use twisted-pair wiring to hook their cards together. The rated transmission speeds are generally low (and that these systems averaged 143,216 to 389,484 kilobits per second in unloaded throughput tests, often faster than your typical 5¼-inch floppy disk), but the speed over the cable

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A Low-Cost LAN Topology
(Media: Twisted-pair wire, or coaxial cable for Ethernet adapter cards)

The low-cost networks that PC Magazine evaluated typically use a station-to-station cabling plan with twisted-pair wires. Some vendors include tap boxes to make the wiring neater, but electrically these networks are wired identically. Some operating systems, including ELS NetWare II, TOPS/DOS, and Network-OS, were tested over an Ethernet scheme that uses a similar wiring plan with coaxial cable.

Network operating systems using NetBIOS, such as LANtastic and Network-OS, can run over a wide variety of network interface cards with different physical topologies and access protocols. In all of these systems except ELS NetWare II and DNA Networks, any node can act as both server and workstation at the same time. In those two instances, the server can be a workstation, but other nodes can only be workstations.

Workstation/server
• LAN adapter card

Shared printer

Workstation/server
• LAN adapter card

doesn't matter as much as you might think. The data access and transfer speed of the hard disk drive on the server and the limitations of DOS in a multiuser environment hamper throughput much more than the transmission cable.

Almost all of these packages either provide or emulate the services of an industry-standard NetBIOS communications module. This means that you can add SNA and other gateways and you can use certain DBMS and e-mail packages that issue NetBIOS calls. (If this paragraph went by too quickly, check out "Networking Acronyms and

Buzzwords," *PC Magazine*, June 14, 1988.)

In every case, the resources available on the network look like local DOS devices to the programs and people using them. Commands sent to drives with names like D:, E:, F:, and G: are redirected over the network to the appropriate network file server. And application programs don't have to be "the network version" to be able to save and retrieve data files from dedicated subdirectories on a network file server.

Similarly, programs sending output to a

network printer address a local LPT port just as they normally do. The print jobs are redirected to a shared printer and queued on the PC acting as a print server until the printer is ready to take the job.

What you gain from these LAN products is not only the ability to easily transfer files between machines and to share printers but also to run programs as diverse as electronic mail and networked spreadsheets. At the price of increased complexity, you can improve individual and group productivity at an affordable price.

—Frank J. Derfler, Jr.

READ 'EM OR WEEP: A PRIMER OF LAN INSTALLATION PITFALLS

With an average total of seven LAN installations a month—and many hardware and software combinations—*PC Magazine*'s LAN Labs has experienced every problem from bad disk-ettes to shorted cables. Here is a brief list, culled from often painful memories, of the more common hazards of do-it-yourself LAN installation:

HIGH-SPEED PROBLEMS Some network designers don't plan for fast CPU clock speeds. We found programs, for instance, that overran their internal synchronization when run on a Compaq 386/20. And we found network interface cards with ROM chips that could not boot on that machine for the same reason. The bottom line: if you are using fast machines, be sure you get a guarantee of compatibility.

IRQ CONFLICTS Almost all LAN adapter cards use hardware interrupts. Unfortunately, the full load of serial ports and hard disk controllers present in modern PCs leaves few interrupt lines unused. Some low-cost adapter cards usually have IRQ2 and IRQ3 available. But several different kinds of add-on I/O devices can use IRQ2, and COM2 serial ports use IRQ3—leaving no room for a LAN adapter.

If you want to network a standard PC or XT that already has IRQ2 and IRQ3

busy, you'll probably have to remove a device to install the network adapter. If you have AT-style machines, you can often buy more-expensive adapter cards that can use the additional interrupts available in the AT architecture. Interrupt conflict is not a problem on Micro Channel architecture computers like the higher-end IBM PS/2s.

MEMORY ADDRESS CONFLICTS Network interface cards use a few different memory locations to transfer data to the CPU. Before the introduction of advanced video displays, there was a lot of room in the PC's memory map for this transfer space; new VGA adapters, however, sometimes claim RAM used by the adapter card. When this conflict takes place, the network adapter card usually loses.

The addresses used on the network adapter are often changeable. Check with the maker of the adapters for the best information about memory map problems.

CABLE TERMINATORS Network cables in a station-to-station wiring scheme are almost always terminated at each end by a resistor in order to prevent electronic echoes and to present the best electronic environment to the adapters. But LAN companies use a variety of termination schemes.

Sometimes the last adapter card auto-

matically terminates the cable. Some systems ask you to install a small carbon resistor between two screws in the last box. Others ask you to use a special plug with a resistor inside. Assume that a terminator is required at each end of a station-to-station wiring system, and find out how it works.

BAD CONFIG.SYS Network programs are often sensitive to specific DRIVER, FILES, and other statements in the PC's CONFIG.SYS file. If one station suddenly loses some or all network capabilities, check to see if anything happened to its CONFIG.SYS.

COPY PROTECTION The phrase "copy protection" isn't used in the network software market. All of the companies, in fact, let you make as many working copies of the software as you like.

But several companies' products won't work if there is another station on the network whose software has the same serial number; TOPS is one example. This "license abuse" scheme can lead to real confusion if people exchange network program files along with other files. The error codes for these serial-number-conflict situations are usually cryptic or misleading. Be as wary of license abuse schemes as you are of copy protection schemes.

—Frank J. Derfler, Jr.

DNA Networks

The acronym *DNA* does not stand for the building blocks of life when used as a network operating system from DNA Networks. This operating system from DNA Networks, however, is low-cost, easy to install, and reliable, as shown by PC LAN Labs' benchmark testing.

The $375-per-station (based on a five-node network) price of the *DNA Networks*, Version 3.35, includes software for up to 16 nodes. And at $295 for each standard workstation adapter, adding PCs is no burden on purse strings. The software includes a security system, a well-designed diagnostic program, a dump facility to read the memory of a adapter boards in case of a network abend (abnormal program termination), a cache program to improve performance, and an installation program. *DNA* did not have a NetBIOS emulator at the time of this review, but the company says it will release a version soon. The *DNA* software also has an interface to programs that use the older Novell *NetWare* semaphore calls for file sharing.

USER-PROMPTED INSTALLATION

To install the DNA Networks server or workstation software, you simply insert the first disk in the A: drive and type "install". The menu-driven system asks some

The small network adapter cards from DNA use thicker cabling than those of some other networks, but they are easy to install and give good performance. The DNA network uses a special master adapter card for any nodes operating as servers.

simple questions, allows you to select options like spooling service, and prompts you to insert the required disks. The installation software creates the necessary subdirectory on the hard disk and modifies or creates a CONFIG.SYS with the values for files and buffers.

DNA's system software is installed as a device driver in the CONFIG.SYS file. This can be a drawback because it means the software loads into RAM at bootup and always takes memory away from applications—even when the network isn't in use. But since the *DNA* program module only takes 8K in the workstation, the impact won't be noticed by any but the most RAM-hungry power user.

DNA's documentation supplies the switch setting for the boards, and during installation a diagram of the adapter board appears on the screen to offer more help. Each workstation adapter board receives a unique ID number, and when you tell the software your station's node number, the display shows you how to set the address switch. *DNA* adapter cards do not use interrupts, so one potential source of conflict with other hardware in the PC is avoided.

Once past system installation, the *DNA* interface is a command-line language allowing for the control of network resources; *DNA* also supplies you with a simple but effective way to handle remote processing on the server. A feature not seen on a lot of networks, the EXEC command allows the workstation to submit a DOS command or batch file on the server for processing. Parameters passed to the EXEC command on the server include the size of the queue or the file to delete from the queue.

And *DNA*'s print-spooling and message-sending capabilities are simple but effective. You can view a print queue and see where your jobs are, and cancel, hold, or resume print jobs. The message capability queues messages at the receiving PC. Entering MSG on the command line will show you the next message in your queue.

DNA ADAPTER CARDS

There are several models of *DNA* adapter cards: first, there are both master and workstation cards. There are also DNA's standard cards and what the company calls Product II cards, which offer increased buffering

and on-board processing capability. The masters of either type are designed to operate in a server and have different price schedules based on their capabilities. We used what we thought was a logical combination of a Master Card Product II board in the server and standard workstation cards in the other nodes during our benchmark tests. DNA also offers Micro Channel cards.

Mapping a virtual drive to a network drive is done automatically when the software is installed. There is no security at the file level, only at the directory level. You can, however, restrict access to a directory with the SECURE command.

DNA Networks' *NetWare* features and their simple implementation make this a reliable, low-cost LAN. The only drawback is the lack of support for NetBIOS. But the low consumption of RAM on the workstation (8K) is something few other network vendors can boast about.—Randol Tigrett

ELS NetWare II

Speed, reliability, and craftsmanship; that's what you look for when you buy a Mercedes. If you don't have the dinero, you buy a baby Mercedes. Likewise with Novell's NetWare: if you can't afford the top of the line, you start with one of Novell's entry-level products, *ELS NetWare I* or *ELS NetWare II*. In this comparison we evaluated *ELS NetWare II* only; *ELS I* is a four-user

> *ELS NetWare II* offers nearly every feature found in *Advanced* and *SFT NetWare*.

system with fewer capabilities.

ELS (for *Entry Level Solution*) *II* is an eight-user LAN software system for data processing, sharing, and storage. It has a $1,495 list price but is often available for less than $1,000 through mail order. It runs as an 8086 dedicated file server or an 80286 nondedicated file server, rather than a peer-to-peer network. All of the shared

Even the smaller versions of NetWare ship in the now legendary "Big Red Box" full of manuals. Installation for ELS NetWare II involves swapping many diskettes and generating a complete operating system, just as it does for regular NetWare. We ran ELS over 3Com EtherLink II cards, but many other options, including the less-expensive ARCnet and Ethernet adapters, should give similar performance.

disk drives, printers, application programs, and data files are located in the network file server.

If you want to use an 80286-based computer as both a file server and a workstation, you have to invest in a megabyte of extended memory to hold *NetWare*. This configuration also takes about 50K of RAM from the DOS operation of the server/workstation.

NETWORK FEATURES *ELS II* contains nearly all of the features found in *Advanced NetWare* and *SFT NetWare*. Supervisor management is entirely menu driven, and users can be added and deleted in groups.

LAN security features include the ability to limit a user's access to designated directories, specific workstations, and certain hours of the day. A supervisor can also limit the number of computer resources a user can tie up over a given period of time.

ELS II's accounting features allow network supervisors to charge for connection time, number of blocks read or written to disk, amount of storage space on disks, and even the number of requests made by a

workstation. Rates can vary by the hour or day. Administrators can even configure user account balances—and log them off when they reach their credit limits, a feature common among mainframes.

The system automatically and transparently protects the network with basic fault tolerance capabilities, including directory and file allocation table (FAT) duplication, read-after-write verification, and disk media defect detection and correction while the system is running.

Another consideration is the ease of upgrading (compatibility and cost) to the more advanced Novell products. Novell's upgrade program allows a specified discount on the retail price of the products. If you are using the workstation/server features of *ELS*, you can expand the network by adding more *ELS* or standard *NetWare* servers.

OPERATING SYSTEM FEATURES *ELS II* runs on most popular network adapters and includes a NetBIOS emulator for IBM-compatible hardware. A built-in remote communication capability allows

access from a remote workstation or branch-office LAN.

System speed is enhanced by directory hashing and caching, file caching, ordering of disk read/write requests, and indexed FATs. Unlike previous versions of *NetWare*, *ELS II* does not require a key card.

NetWare ELS, as do the other *NetWare* operating systems, comes with software drivers for many different network adapter cards. We ran it over Ethernet because that is a typical configuration, but if you want to reduce the price by as much as $200 per node while keeping a similar level of performance, you could choose ARCnet cards. We ran *ELS NetWare II* as a non-dedicated server with *NetWare* operating in over a megabyte of RAM, and it turned in benchmark-test times that were often far ahead of the pack.

NO SHORTCUTS TO INSTALL The good news is that *ELS II* comes with more than 20 manuals and numerous quick reference guides; installation is menu driven. The bad news is that you need to buy a bookcase, and the installation process is not for the fainthearted.

The computer novice should consider paying a professional to install the soft-

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ware. The computer literate should be able to complete the initial installation within a day (all stations talking to the file server and vice versa), assuming there are no hardware problems. But your LAN's customization will require considerable forethought, organization, and planning. The menu-driven utilities facilitated the customization implementation.

Novell offers a number of options in supporting its products, including contract support, dial-up bulletin board using CompuServe, classroom training, and computer-based training, not to mention diagnostic tools. Frontline support comes from its distributors and dealers.

Overall, *ELS II* maintains the *NetWare* standard as set by its elders. It's powerful, flexible, and fast. Its applications lie in the requirement for a speedy centralized database access and update by a limited number of users. While not the cheapest entry-level system, its applicability to growth and *NetWare* compatibility are assets that can't be ignored.—**Mike Byrd**

LANsmart

The Smart, Simple Way to Networking Operation is the title of Localnet Communications' brochure for the **LANsmart** network operating system. There's truth in the company's claim. *LANsmart's* simplicity comes from its use of pop-up window menus that prompt the user along. Its smarts come from the ability to use DOS

3.1 file/record locking, NetBIOS services, disk cache, the compact size of the programs, and the inclusion of extensive communications functions, including instantaneous message sending and a multiuser on-line chat capability.

The $395 *LANsmart* software fits on one 360K disk and comes packaged with a 178-page manual. Each $249 DLink node's interface card comes individually packaged with a diagnostic disk, 10-foot telephone-type cable, installation manual, and RJ-11 connector block to interface to the trunk cable. The DLink network hardware uses twisted-pair wire to transmit data at the rate of 1 megabit per second over distances of up to 4,000 feet.

CHALLENGE TO INSTALL Installation is simple on the surface, but you may need a detailed knowledge of the PC to complete the process. After you select a unique node number for each expansion card, you can insert the half-sized card into any 8-bit slot. The diagnostic disk that comes with each card has one program on it, TESTN, for testing the installation. The first part of the program checks to see if the board has been installed properly and does not conflict with any other boards in the system.

In one of our installations the TESTN program gave us the message "Self-test fails—consult manual." The manual suggested changing the base memory address. After we took the card out, changed the jumper that sets the memory base address,

and reinserted the card, TESTN gave us the same message. The next alternative was to change the IRQ vector. In our experience, IRQ problems are much more common than memory conflicts; this case was no exception.

The second diagnostic test checks out the link between two nodes. This test produced the message "No response from remote PC. On-line test fails." Suggestions in the installation manual were to no avail. A phone call made to Localnet yielded the suggestion that we install and try out the *LANsmart* software because "sometimes the self-test program fails, but the network is still OK." We followed the customer service rep's advice, and the *LANsmart* operational software's installation went

> *LANsmart* allows any resource available on the network to be shared by other users; passwords may be used to gain access.

smoothly and presented no further diagnostic errors.

The *LANsmart* software is simple to install. For hard disk systems, a subdirectory called LANSMART is created and the contents of the distribution disk are copied into it. The only other program needed is DOS's own SHARE.EXE.

NO SMARTING FROM LANSMART
The network software can be run either as a standalone program or as a pop-up window. The first time the LOGON program was executed, it apparently conflicted with *SideKick*, which had already been loaded into the system. Executing the LOGON program locked up the computer, and the system had to be powered down and rebooted. After we removed *SideKick* from the AUTOEXEC.BAT, the LOGON program worked fine.

LANsmart allows any resource available on the network to be shared by other

Low-Cost LANs: Summary of Features
(Products listed in ascending price order)

The following commentary analyzes some of the terms in this table of features. The phrases in bold type are listed in the same order as in the left column of the table.

All systems allow both menu operation (to make resources available) and a command language (to help network administrators further automate functions for their users through batch files).

Price per node Since few of these LAN companies package their products on a single-node basis, we computed a price per node based on an installation with six nodes.

Copy protection This is still found in some networking software products. In the case of *TOPS/DOS*, it takes the form of serial numbers checked by the running program to insure they are unique.

Unloadable from RAM The ability to unload the network program from RAM easily, without rebooting, lets users reclaim RAM space when the network is not in use.

Disk caching In these predominantly DOS-based networks, a disk cache system is an effective way to increase network speed.

	Net/30 Invisible Software Inc.	Network-OS CBIS Inc.	LANtastic Artisoft Inc.
Price per node	$108	$160*	$199
GENERAL INFORMATION			
Copy protection	○	○	○
Required RAM (server/workstation)	100K/60K	145K/60K	40K/10K
Unloadable from RAM	○	○	○
Disk caching	●	●	●
NetBIOS network	○	●	●
SMB protocol	○	●	●
Diskless support	●	●	○
E-mail	●	●	○
ADMINISTRATIVE FUNCTIONS			
View print queue	●	●	●
Customize separator page	○	○	●
Log errors	○	○	●
Track resources	○	○	●
List users	●	●	●
Group access	●	○	●
Password access	●	●	●
TECHNICAL SUPPORT			
Telephone	●	●	●
Other		CompuServe	tape	BSS

■ = Editor's Choice ● = Yes ○ = No
* Plus interface cards purchased from another source.
† A nondedicated server requires additional RAM

NetBIOS services Having NetBIOS services available on a network facilitates adding gateways and certain other applications.

SMB protocol Networks that follow the Microsoft Server Message Block protocol can interoperate with servers running IBM's *PC LAN* and similar network operating systems.

Diskless support Some networking software and adapter cards can be configured to support diskless workstations that get their DOS boot from the server.

E-mail A yes answer indicates that the network operating system includes true store-and-forward electronic mail as part of the standard package.

View print queue The ability to view the print queue gives users information about the printer-sharing process.

Customize separator page Customized separator pages can speed the distribution of shared printers' output.

Log errors The networking software often keeps a log of such errors as bad packets and data blocks.

Track resources Does the networking software provide a way to track the use of resources by user or group?

List users Does the networking software show which parties are using the network?

Group access Can access rights be contingent on what department or group the user belongs to?

Password access Can specific resources such as subdirectories or printers be protected by passwords?

Technical support Beyond telephone support, some companies offer an electronic bulletin board to answer questions and provide program updates and patches. Some vendors also maintain CompuServe forums to support their products. Other options include videotape courses on network installation and operation, and classroom training.

	PC/NOS Corvus Systems Inc. $243	ELS NetWare II Novell Inc. $249*	LANsmart Localnet Communications Inc. $315	DNA Networks DNA Networks Inc. $362	ViaNet Western Digital Corp. $400	TOPS/DOS TOPS $428	DataLAN 4 Datapoint Corp. $432	POWERlan Performance Technology $498
Memory	194K/66K	640K/60K†	150K/110K	128K/8K	106K/96K	180K/79K	145K/60K	145K/60K
	●	●	○	●	●	○	●	●
	●	●	●	●	●	●	●	●
	●	●	○	○	●	○	●	○
	○	●	●	○	○	○	●	●
	●	●	○	○	○	○	○	○
	●	●	●	●	●	●	●	●
	●	●	●	●	○	○	●	●
	●	●	○	○	○	○	●	●
	●	●	●	●	○	○	●	●
	●	●	○	○	○	○	●	●
	●	●	●	●	●	●	●	●
Technical support	BBS	CompuServe, tape, class	BBS	BBS	BBS	BBS	tape, class	tape

DLink uses a tap box system that gives your network wiring a neat appearance and lets you run a single wire to each node, but someone has to sit down with a screwdriver and wire strippers and build the network cable. The DLink adapter cards are easy to install, and the LANsmart operating system gives good performance.

users; security can be added using a password to gain access to a resource. The pop-up network program can be activated by pressing the Ctrl-Alt-Break keys simultaneously. Once this menu is brought up, many functions can be executed, including allocating a resource, sending a message to

another node, monitoring the network, and manipulating the print queue. The user preferences can be stored in a start-up configuration file to be loaded when the system is booted.

A facility to print banner pages between print jobs by a shared system printer is available. One minor annoyance of the software was that on a system with a CGA card and monochrome monitor, the software attempted to use colors that made the text hard to read.

Other options available but not tested include e-mail, remote booting (which facilitates a diskless system), a screen monitor system (to allow sending screens and to control other nodes from a master node), the DLink bridge (for connecting to Ethernet networks), and an asynchronous communication server (to control multiple serial devices such as modems).

After we overcame a few hurdles in getting the system installed, LANsmart performed well, especially considering its status as a low-cost LAN. And with little difficulty the pop-up menu function allows access to the network software.

—Paul Ferrill

LANtastic

Artisoft calls its *LANtastic* network operating system the smallest on the market. Memory requirements are found in a product brochure as "less than 40K on a server and 10K on a node." These claims, we found, are true—and we also learned that small code doesn't mean limited features. *LANtastic* is a true peer-to-peer network allowing for hard disk, floppy disk, and printer sharing among all nodes. Full DOS 3.1 file- and record-locking support is included, and *LANtastic* uses a full implementation of NetBIOS for all network communications.

A $399 *LANtastic* starter kit comes with two adapter cards, a LAN adapter user manual, a two-user version of the *LANtastic* software, one 15-foot cable, and terminators. The software fits on one 360K disk and comes with a 112-page manual. This guide is well written and filled with illustrations that make the installation process much easier. The system

LANtastic's installation is a breeze using the LAN adapter user manual.

overall transmits data at the rate of 2 megabits per second and will support total network cable lengths of over 1,500 feet.

SETUP AND CONFIGURATION *LANtastic's* installation process is a breeze using the LAN adapter user manual. One example: the proper jumper settings for either XT- or AT-type machines are illustrated in full detail. Once these jumpers are set, the cards can be inserted into the machines and the cable and terminators attached. Once the cards are in place, you install the LANBIOS software. A special utility program called LANCHECK tests the network and displays active nodes.

The *LANtastic* network adapter is a half-size card with an on-board 10-MHz coprocessor, 32K of buffer RAM, and a 2-megabit-per-second link to other adapters.

Network without a network.

Before buying a LAN, take a hard look at your company's needs. Then take a look at the Logical Connection.

It could be all the network you need. A peripheral sharing device. Simple and affordable. No cards. No node disks. No file server. No node disks. Just your equipment, logically connected for economy and ease of use.

Connect up to six PCs on each Logical Connection. To lasers. Printers. Plotters. Modems. Switch from one device to another from any connected PC. Pop up the on-screen menu, and it's done.

Link as many as 45 Logical Connections to really expand your connectivity power. Up to 225 users sharing

those costly peripherals. Make the logical choice. Network without a network. For as little as $700. From the makers of Fastback Plus.

All the network most users need.

The cards can use IRQ 3, 4, or 5, so there's room to maneuver if you run into conflicts with serial ports or other I/O devices in the computer. We had no problems running the *LANtastic* cards in our fast Compaq, Dell, and IBM machines.

The network software allows either menu-driven or command-line access. The command language lets network administrators set up batch files to configure server resources and the way that client workstations use them. But if you don't want to bother with the command language, a windowed menu system essentially leads you by the hand through the setup process and then saves the results. Along the way, any resource attached to the server can be made available to the whole network; this includes support for CD-ROM drives.

LANPUP AT YOUR FEET LANPUP is *LANtastic*'s pop-up utility package. You don't have to load it, but it offers immediate access to the network commands and also to *LANtastic*'s electronic mail. We found it particularly useful for gaining fast access to the printer queue. In keeping

with the small size of the rest of the software, LANPUP takes just 5K of RAM.

If you do load LANPUP, *LANtastic*'s nice e-mail facility lets you send messages to any user registered on the network. The message software can either send a file or allow text to be entered from the keyboard with a built-in editor.

LANtastic has a sophisticated security feature, combining password log-on with a separate resource-access-control list. If desired, simple networks can run wide open without any network security. The first level of protection comes from traditional password access. But *LANtastic* also adopts a practice used in minicomputer operating systems: it lets the administrator set up access-control lists for nearly any level of resource. This means that access even to individual files can be limited by the contents of an access-control list. The types of network access that the network manager can specify are read, write, create, rename, make directory, file lookup, delete file, delete directory, execute programs, and modify file attributes.

An auditing facility is also included to document who had access to what files

when—an audit function that's powerful enough to form a client billing system.

PRINTER SHARING LANtastic does an excellent job of sharing printers across the network. Its print queue facility enables any user with the appropriate access privilege to print to a central printer on the network. The queue manager will print the jobs spooled on the print server's hard disk. Banner pages can be inserted between the print jobs, and they can be customized for each user.

Throughout *LANtastic*'s operation, help is available in all of the network commands through the Net Help command. This gives a simple description of the command and the parameters needed to make it work. In addition, Artisoft offers telephone technical support and a computer bulletin board service for its customers.

Another plus: Artisoft markets a separate $295 product called the *Network Eye* that works with any NetBIOS LAN. It lets two stations link across the network so that one can remotely control the other and run character-oriented programs.

The *LANtastic* system is truly a pleasure to use. The number of features included in the basic system makes it one cost-effective way to implement a small network.—**Frank J. Derfler, Jr., and Paul Ferrill**

The small LANtastic interface cards include memory that holds a significant portion of the networking software in each node and reduces the impact on RAM. The cables are available in premade sets and are easy to connect and extend.

Benchmark Tests: Low-Cost LANs

The best indication of low-cost LAN performance under typical heavy load conditions can be found in the two- and three-station load sections of the Database Load benchmark test. But don't stop there: enough interesting results are here to keep a conventional LAN guru arguing for a week.

Before looking at anything, note that not all the systems we tested were in their lowest-cost configurations. Specifically, *ELS NetWare II* and *Network-OS* were run over Ethernet cards even though both operating systems can run over a variety of network interface cards, some of which cost less than Ethernet. We tested these systems over Ethernet because most installations are configured this way and because DOS-based operating systems are limited mainly by the speed of data going to and from the server's hard disk, not by the network interface cards. The bottleneck at the server's hard disk is clearly shown by the dramatic drop in throughput for *Network-OS* between the no-load and loaded conditions.

Ethernet is certainly responsible for the top-rated unloaded (zero-station) performance of *ELS NetWare II* and *Network-OS*, and for the scores achieved by Novell's high-end *Advanced NetWare* (provided for comparison). We chose to test other Ethernet-capable networks, such as *LANtastic*, using this less-expensive cards with which they are commonly configured, although they would have registered greater no-load throughput scores running over Ethernet cards.

You'll find two entries for *TOPS*. The older *TOPS* network interface cards are among the slowest in the industry, and since a major feature of *TOPS 2.1* is its Ethernet interface, we provide benchmark test results for *TOPS* both on the then *TOPS FlashCard* and over Ethernet. Note that *TOPS* over Ethernet degrades very little during our Network Throughput Under Load test; evidently the *TOPS* program stores data in workstation buffers and answers some small data requests from the buffers. This technique works for certain applications, but it loses effectiveness when the data request vary as they do in our other tests.
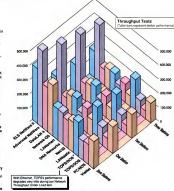
Without a doubt, the special file system used in *ELS NetWare II* is a factor in its demonstrated performance edge over the DOS-based LANs. You pay a price for this performance, however, in terms of either a dedicated server or an extra megabyte of RAM.

Certainly the strongest test results are those shown by *ELS NetWare II* under our Database Load test. We checked the results several times, and it is absolutely true that the throughput of the timed test improved when the database load was activated. This can be attributed to the system's disk-caching and data-handling architecture. As the queuing and caching software hit their stride in this particular combination of disk drive and files, response times and throughput improved.

Network-OS gains its performance boost through the use of a highly effective disk-cache program. *ViaNet* suffers from the lack of such a facility. We ran *ViaNet* over Western Digital's StarLAN network adapter cards, but the results under disk load would have been similar using other types of adapters. The scores for Performance Technology's *POWERlan* are not shown here because the product is, for all practical purposes, the same as *DataLAN 4*.

Throughput Tests

(Taller bars represent better performance)

With Ethernet, *TOPS*'s performance degrades very little during our Network Throughput Under Load test.

Network Throughput Under Load

(Results given in kilobits per second)

Software	Interface Card	Zero Stations	One Station	Two Stations	Three Stations
ELS NetWare II	Ethernet	389,484	223,418	197,874	184,227
Advanced NetWare	Ethernet	541,321	478,132	438,857	396,387
DeteLAN 4	ARCnet	313,469	130,031	119,649	112,116
Network-OS	Ethernet	359,298	168,791	139,477	140,273
LANsmart	DLink	220,215	185,060	162,539	140,273
DNA Networks	Master Card Product II	219,821	108,551	93,302	86,050
Net30	Model 200	195,668	171,142	149,671	128,670
LANtastic	LANtastic	212,963	120,707	93,801	75,064
TOPS/DOS	Ethernet	241,889	240,000	221,405	219,428
TOPS/DOS	TOPS FlashCard	136,230	126,419	104,312	99,096
PC/NOS	Omninet 1	143,216	77,969	60,532	55,321
ViaNet	StarLAN	193,880	188,745	167,301	138,874

* with Ethernet

Throughput Tests
(Taller bars represent better performance)

Hard Disk Access Load
(Results given in kilobits per second)

Software	Interface Card	Zero Stations	One Station	Two Stations	Three Stations
ELS NetWare II	Ethernet	389,484	332,108	286,433	254,409
Advanced NetWare	Ethernet	541,321	503,606	398,961	328,556
DataLAN 1	ARCnet	313,469	178,604	105,476	74,247
Network-OS	Ethernet	359,296	181,238	107,600	79,073
LANsmart	DLink	220,215	127,073	79,533	60,741
DNA Networks	Master Card Product II	219,821	140,756	98,619	86,413
Net/30	Model 300	195,868	99,560	61,717	42,125
LANtastic	LANtastic	212,963	120,825	72,452	51,979
TOPS/DOS	Ethernet	241,889	107,600	66,278	47,116
TOPS/DOS	TOPS FlashCard	136,230	82,139	63,080	47,213
PC-NOS	Omninet 1	1-3,216	72,197	57,690	51,520
ViaNet	StarLAN	193,880	73,747	41,225	36,009
	with Ethernet				(continues)

Net/30

To the general public, the Invisible Network is truly invisible. But in the next few months, the Invisible Network will soon be visible on the sales market via consultants, phone orders, direct mail, and resellers. Invisible Software's hopes are to increase distribution through all sales channels, especially in the area of retail.

The Invisible Network offers easy installation, speed, and low memory requirements, while not burdening users' wallets with an expensive price tag; its per-node price, in fact, is the cheapest of those reviewed here. Retailing at the low cost of $215 for two nodes using the Model 200 network cards and $315 for two nodes using the Model 300 cards, the Invisible Network comes with the hardware to configure two workstations. Also included in the package price is its own network operating system, called Net/30.

Net/30's features include pop-up menus, extensive help screens, and a remote boot capability for diskless workstations. A complete security system controls access to directories by individual or groups. Printer queue control handles output to any printer in the network. And Net/30 offers shortnames for workstations, directories, and printers. The command language is similar to the one used in Microsoft's MS-Net; however, it also borrows some command verbs from NetWare, like the MAP command. If you're not satisfied with the Net/30 software, the Invisible Network comes with a NetBIOS interface that makes it compatible with other popular network software such as Novell's NetWare 2.0a, IBM's PC LAN program, and Torus's Tapestry.

Invisible Software offers users a newsletter packed with information about the latest upgrades in hardware and software. The company offers free telephone support plus support via CompuServe.

NET/30 E-MAIL Net/30 includes a basic station-to-station message system that only uses 5K of memory. To use this message system, both sender and receiver must have the mail program loaded. The e-mail system allows you to send a one-line message to anyone on the network. It prompts

Benchmark Tests: Low-Cost LANs

Testing Procedures

The PC LAN Labs benchmark tests are written in C and are independent of commercial software. Each load station operates at a real times than that of a PC in a typical heavy-use environment (such as a data entry operation). We have designed these tests so that a single station represents five to ten times the load of a user performing an interactive task (such as updating records) on a typical network.

The Network Throughput Under Load, Hard Disk Access Load, and Database Load benchmark tests each report the throughput recorded during the performance of a standardized task on the network. To obtain the figures shown here, we run a test program performing a sequential create, a sequential write, a random read, and a random write of a large file. The record sizes used in these activities systematically rotate among 16K, 4K, and 512 bytes. The results shown represent the average throughput over a period of time sufficiently long to ensure consistency. Usually a 1MB file is used, but this size may be adjusted for unusually fast or slow networks.
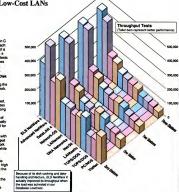
While the timed test is run, we load the network with other special programs. The Network Throughput Under Load test puts a heavy load on the network interface cards, media, and access protocol) while placing a minimal load on the hard disk and file server software. In this test, each load station continuously reads and writes its own 1-byte data file, changing the data each time. This creates a high volume of data packets and strong contention at the network interface level.

The Hard Disk Access Load test heavily loads the hard disk and disk-caching system. Each load station randomly accesses its own 100K data file using a 1K record size. Data written to the file is changed each time. This test is influenced by the algorithms used in the cache scheme, the software's efficiency in handling the disk, and the speed of the drive and controller.

The Database Load test reflects the system's record-locking support and the way it handles a number of random simultaneous accesses to a common file. Each load station accesses a common database consisting of an index file and more than 4MB of data. Half of the accesses are a simple search of the index file with an accompanying access to a record in the data file. One quarter of the accesses perform the same operation but also lock the data record and update its contents. The remaining accesses update the index file and the data file. DOS 3.1 file- and record-locking calls are used. All benchmark tests were run using a Compaq 386/20 as the file server; no applications were run on this machine. Workstations were Dell System 200 computers running at 12 MHz (with an 6.33-MHz data bus speed). Test results are reported in terms of throughput, measured in kilobits per second. These results were derived from repeated runs using files of 1MB.

Throughput Tests
(Taller bars represent better performance)

Database Load
(Results given in kilobits per second)

Because of its disk-caching and data-handling architecture, ELS NetWare II actually improved its throughput when the load was activated in our Database Load test.

Software	Interface Card	Zero Stations	One Station	Two Stations	Three Stations
ELS NetWare II	Ethernet	389,484	461,954	450,109	438,857
Advanced NetWare	Ethernet	541,321	453,485	441,484	388,772
DataLAN 4	ARCnet	313,469	184,227	173,559	165,383
Network-OS	Ethernet	359,296	170,666	153,216	150,588
LANsmart	DLink	220,215	119,300	112,941	106,759
DNA Networks	Master Card Product II	219,821	110,802	101,386	97,990
Net/30	Model 200	195,668	96,603	88,850	89,043
LANtastic	LANtastic	212,963	134,299	97,756	86,414
TOPS/DOS	Ethernet	241,889	125,259	93,302	59,592
TOPS/DOS	TOPS FlashCard	136,230	82,525	66,746	57,907
PC/NOS	Omninet 1	143,216	79,792	60,117	53,129
ViaNet	StarLAN	193,880	65,530	51,810	45,176
* with Ethernet					(ends)

the receiver to reply as soon as he has returned to the DOS prompt. There's another plus: more capable third-party e-mail products on the market will mesh well with the *Net/30* software. The article "Workgroup Productivity Boosters" (*PC Magazine*, June 14, 1988), for example, contains reviews of seven e-mail products.

Invisible Software's adapter cards use an implementation of the CSMA/CA protocol called HCA (Heartbeat Collision Avoidance); the HCA implementation

> The Invisible Network's
> cards use little
> RAM—they keep
> NetBIOS in ROM.

meets the IEEE 802.3 MAC-level standards. This collision-avoidance scheme uses a special "heartbeat" timing signal carried on a separate pair of wire to synchronize all the stations on the network. It specifies that one master station (not necessarily the server) should set the heartbeat for the network. One drawback: the master station has to be turned on before any other network station.

Invisible Software markets two versions of its network interface cards. The ROM chips on the cards hold much of the network software and reduce the impact on the available RAM, but in some tests the ROM chips were not fast enough to boot with 20-MHz machines. The Invisible Network wiring scheme uses thin telephone-type cable that makes it easy to wire between nodes.

Both the Model 200 and Model 300 cards use twisted-pair cable to daisy-chain up to 44 workstations. The speed and the length of the cable are interdependent. If you set the Model 300 to run at 3.0 megabits per second, for example, then the limit of twisted-pair cable is 500 feet. However, running at 1.8Mbps on either model gives the user 1,500 feet of cable to use. And if you wish to run even slower, the network could be 2,000 feet in length. Memory requirements range from 30K to 70K depending upon the options used.

ALMOST INVISIBLE RAM USAGE
The Invisible Network adapter cards use little RAM because they keep NetBIOS in ROM on the card. One characteristic we found is that the ROMs are not fast enough for 20-MHz machines. While we had no problem using the cards in our 12-MHz Dell 200 AT clones, none of the cards would run in our Compaq 386/20 until we disabled the on-board ROM and read in NetBIOS from a diskette. While this procedure is explained in the manual, it's worth factoring into your decision.

The Invisible Network is not difficult to install, but the task requires some attention to detail. Each network card needs a unique address that's set using a DIP switch; you have to track these numbers and avoid duplicates. And since the twisted-pair wiring topology is station-to-station, this system isn't a great fit for using existing telephone cable. But it is easy to install your own wiring around the floor molding or in false ceilings. The batch file INSTALL moves the networking software to the floppy disk or hard disk drives of the stations, and preparation of a boot disk is easy using the file PREPARE.

The network menu allows only the user of that particular workstation to determine how other users may access data from it. It does not help the user to access other workstations' data; instead, you must become considerably fluent in the use of the MAP command. Using batch files to map local DOS drive names to networked resources really does make the network invisible.

Low cost need not mean lackluster performance. For a reasonable price, the Invisible Network offers in return simple installation, sufficient speed, and low memory requirements.—**David Byrd**

A Few Words
Most Celebrated
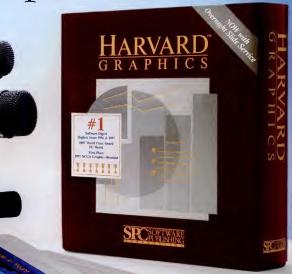
Thank you. For those of you who haven't heard, Harvard Graphics from Software Publishing has gotten a lot of recognition from the trade press. Why, you may ask? Certainly our crisp, high-speed output helped influence InfoWorld readers to name us Product of the Year. And the easy access to so many chart and graphing options must have helped PC World's audience give us their World Class Award for the second year running.

Actually it must have been all those things and more. Otherwise why would PC Magazine call Harvard Graphics "the de facto standard" software for business graphics?

Network-OS
POWERlan
DataLAN 4

It isn't unusual for a product to appear in the LAN marketplace under several different corporate logos. Microsoft's *LAN Manager*, for instance, will be wrapped in a dozen different corporate colors by the end of the year. Often, the question for the buyer becomes, who offers the best support? The same situation applies to a product called *Network-OS*.

Network-OS is a LAN operating system developed and sold through retail channels by CBIS. But this same core operating system has been adopted, combined with other value-added features, renamed *POWERlan*, and presented to the retail market by Performance Technology. There's more: the Performance Technology package itself has been adopted, combined with still other support features, and offered by Datapoint as *DataLAN 4* in the retail channel. Here's a look first at the major features of *Network-OS* as distributed by CBIS, then at the value-added features that you get from Performance Technology and Datapoint.

THE CBIS KERNEL *Network-OS* is a well-designed LAN operating system that can run on nearly two dozen different network adapter cards, the drivers for which are included. CBIS sells *Network-OS* through distributors and dealers for $160 per node; a site license costs $1,280.

Menus guide all *Network-OS* activities, from installation through resource sharing. We found the menus easy to use, but—as is typical for systems like this—you have to know a lot about pathnames and resource names to work your way through the menus.

During installation, you can supplement the menus with a videotape that describes setup of the network hardware and software. The tape is useful and should at least help to bolster the confidence of an inexperienced installer. If it doesn't, fear not: CBIS supports *Network-OS* with a free tech-support hotline, through its dealers, and with inexpensive 2-day courses held in Atlanta.

Under *Network-OS*, a node can function simultaneously as a server and a workstation. This configuration, however, takes about 180K of RAM in addition to that used by DOS. You can install a node as solely a client workstation, in which case the software requires about 90K of RAM. One nice feature of the software is that it does not load through a "DEVICE =" statement in CONFIG.SYS as do some operating systems. This allows you to load the LAN software only when you need it and to unload it with POPDROP or similar menu-management utilities if you need to reclaim the RAM.

Network-OS offers excellent capabilities for printer sharing. Any machine with a hard disk, for example, can make as many as five printers available for the network. The hard disk is used to hold print jobs until they are queued for service by a particular printer. Menus make it easy to tailor the separator page printed between each job. And the print spool file closes after 2 seconds of not receiving incoming data. This avoids the problem some other operating systems pose, which forces users to close an application program before the job is moved to the printer.

CACHING PROGRAM INCLUDED Caching software is particularly important in improving the performance of servers because the hard disk is usually the slowest data transmission device in the network. The *Network-OS* package includes both a hard disk file-caching program and a utility that reports on its operation. The utility notes the percentage of read requests satisfied by the cache while the system has been operational.

Among other significant features, *Network-OS* offers full NetBIOS services, making it easy to install NetBIOS devices like gateways to mainframes on the network. In addition, the operating system uses the Microsoft Server Message Block format to request services across the network. Although we didn't test this capability, it should mean that the *Network-OS* workstations can interact with servers on the network running the IBM PC LAN and Microsoft/3Com *LAN Manager* operating systems.

A security system in *Network-OS* operates on the principle of assigning a password for system access and then optionally putting passwords on individual resources

Network-OS, *the LAN operating system sold by CBIS, offers excellent printer-sharing facilities, full NetBIOS services, disk-caching software, and drivers for several different network operating systems. Combined with third-party network interface cards, it forms the basis for two value-added products: POWERlan from Performance Technology and DataLAN 4 from Datapoint.*

The Network Hardware Solution.

like disk drives, subdirectories, and files.

We liked the *Network-OS* documentation. It includes good introductory information, accurate diagrams of the menu screens, a logical arrangement of the data, appendices with detailed technical data, and an excellent indexing system. The sections on interrupts and memory maps are rare in products of this price and very valuable to people trying to sort out incompatibilities during a system installation.

The CBIS version of *Network-OS* comes with a three-user e-mail package that is not resold by Performance Technology or Datapoint. This package includes both an on-line conferencing capability and a bulletin board. The mail package lets you import and export messages to and from ASCII files, but it doesn't have the ability to attach binary files to an ASCII message.

THE POWERLAN BOOST Performance Technology adds a powerful hardware interface to the CBIS *Network-OS* operating system, calls it POWERlan, and combines it with other products to compile a family of network alternatives.

The *POWERlan* software is sold in a $595 four-workstation version, an $1,195 eight-workstation version, and a version with an unlimited user license for $1,995. The 8-bit POWERrim network interface cards sell for $299 each; the 16-bit, $795.

Selling the products is a team that includes people with a lot of experience in the ARCnet networking system. They market their own ARCnet cards and have developed a NetBIOS module for the cards that takes advantage of some of the features built into their architecture. This makes the NetBIOS module smaller and faster than the drivers supplied by CBIS.

The Performance Technology network interface hardware will remotely log you from any server using the Microsoft Server Message Block protocol. In other words, diskless workstations on a LAN can boot from *PC LAN* or *LAN Manager* servers as well as from *POWERlan* servers.

In addition to POWERlan, Performance Technology has its own operating system, called POWERserve. Very fast and capable, the $2,495 POWERserve requires a dedicated server to run. It retains DOS on the server but does most of its

Network-OS
CBIS Inc.
5875 Peachtree Industrial Blvd.
Building 100, Unit 170
Norcross, GA 30092
(404) 446-1332
List Price: Single node, $160; site license, $1,280.
Requires: A nondedicated server with 640K RAM and appropriate network interface cards, purchased separately.
In Short: A DOS-based network operating system with good printer-sharing features and the flexibility to run on many different network interface cards. The system includes a hard-disk-caching program and a three-user e-mail package that is not sold with value-added versions. Not copy protected.
CIRCLE 397 ON READER SERVICE CARD

POWERlan
Performance Technology
800 Lincoln Ctr.
7800 IH 10 West
San Antonio, TX 78230
(800) 825-LANS
(512) 349-2000
List Price: POWERlan four-user license, $595; POWERlan eight-user license, $1,195; POWERlan unlimited license, $1,995; POWERserve dedicated server software, $2,495. POWERrim 8-bit ARCnet network interface card, $299; POWERrim II 16-bit ARCnet network interface card, $795.
Requires: A nondedicated server with 640K RAM and appropriate network interface cards.
In Short: A repackaged version of the CBIS Network-OS product with an improved NetBIOS for ARCnet and added support. POWERserve, a proprietary operating system, is also available for use with a dedicated server. Not copy protected.
CIRCLE 398 ON READER SERVICE CARD

DataLAN 4
Datapoint Corp.
Direct Marketing Services
Mail Stop H56
9725 Datapoint Dr.
San Antonio, TX 78284
(800) 334-9290
List Price: DataLAN 4 Intro Pac., $1,295 (includes POWERlan software, three Datapoint ARCnet cards, and four-port ARCnet hub).
Requires: A nondedicated server with 640K RAM.
In Short: A repackaged version of POWERlan that includes 8-bit ARCnet cards. Similar in both price and performance to POWERlan. Not copy protected.
CIRCLE 399 ON READER SERVICE CARD

work by going around DOS for faster operation. POWERserve gets most of its speed by using a huge cache: the system can dedicate up to 32 MB of RAM to cache. It can also address up to 12 gigabytes of disk drive storage and connect up to 255 simultaneous users.

POWERserve will get its own review later in comparison with its peers from Novell, 3Com, and DSC. But for the purposes of this review, keep in mind that POWERlan has a big brother capable of high performance.

Performance Technology supports its products with a traveling team that trains distributors, and the company offers free technical support to its customers.

THE DATAPOINT DIFFERENCE To make up the *DataLAN 4* package that we benchmark tested for this review, Datapoint takes the POWERlan software and combines it with network interface cards to put together a single package that brings two workstations plus the server on-line. The $1,295 *DataLAN 4* package includes the POWERlan software, three 8-bit Datapoint ARCnet cards, and a four-port passive ARCnet hub.

Datapoint is a company with a long history in the computer business. It markets a line of minicomputer products and a unique terminal that handles not only data but also two-way television images for video conferencing. In addition, the company has a toll-free number for customer support and offers worldwide on-site service.—*Frank J. Derfler, Jr.*

PC/NOS

The first thing to know about Corvus Systems is that the company's network adapter hardware called Omninet and an operating system called PC/NOS. *PC/NOS*, Version 2.0, is Corvus's latest entry into the crowded LAN arena. Don't confuse Version 2.0 with the original *Omninet* operating system that Corvus introduced some years ago. Corvus went to school after releasing the original product, and the result is a solid network operating system.

Corvus offers a four-node starter kit including four Omninet 1 cards, PC/NOS,

and all the necessary plug-and-click cabling for $995. Adding nodes is easy since you need buy only the card and cables; the licenses for all the nodes your hardware will support (100 in the case of Omninet) is included in the starter kit. In addition to the Omninet 1 cards, which operate at 1 megabit per second and use the CSMA/CD protocol, *PC/NOS* will also work on the ARCnet, IBM Token-Ring, Ethernet, and Tandy's Link networking systems.

RAM requirements for *PC/NOS* vary depending upon how you configure the software. A node acting as a workstation, for instance, requires 66K. And a computer sharing a printer and hard disk uses 174K plus 1K per every megabyte of disk space shared. You can not unload the network drivers and software without rebooting your machine.

TRICKY INSTALLATION Corvus's installation program should be easy to use; unfortunately, we had a problem with its copy-protection scheme, which works with hidden files to limit the number of installations. This and a repeat experience with a bad diskette gave us more than a lit-

tle frustration. Ordinarily, however, you type "a:install" and answer questions about the configuration. The install program modifies the CONFIG.SYS and AUTOEXEC.BAT files to add the proper commands.

After installation, the Corvus program *NetView* (not to be confused with IBM's program of the same name) links the computer to the disk drives and printers available to the user. The resources available to any one user are controlled by a security system based on privilege levels. *NetView* also lets the user see shared resources in a screen diagram. Initially, the maze of windows can be difficult to navigate, but if you follow the manual to make your first connections, the rest of them are easier to make.

Using the Corvus command language, the network manager can create batch files to link the user to the proper resources. Even though this language does not follow the standard Microsoft *MS-Net* command structure, it is thorough and easy to understand.

One annoying problem is the inability to use the computer if the network card is

out of your machine. The software will crash if it doesn't find the network card. A better solution would be to report an error and exit to DOS. You must modify or rename your CONFIG.SYS and AUTOEXEC.BAT files before you remove the card.

MESSAGING FUNCTIONS *PC/NOS*'s messaging and print spooling portions are not as powerful as those of some larger and more-expensive networks, but they'll meet the needs of most installations. The messaging function has the ability to send messages to users who are currently logged in, but it lacks the ability to store and forward and attach binary files.

The print spooler is more complete. It allows the user to view the print queue and change the priority of print jobs. The network manager also has the ability to change the priority of any job in the cue.

One feature that sets *PC/NOS* apart from the low-cost LAN group is that it includes *NosTalk*, a full-fledged communications program. This program lets you share modems on the network for sending data to remote locations and checking e-mail services. Another unique feature is Virtual Console, which lets a user take over the keyboard and screen of another person's workstation. This feature is very

The wiring plan of the Corvus Omninet network features cables with tap boxes that allow a one-wire connection to each PC instead of the two used in other systems. Each card, however, uses a slide-on connector that takes a steady hand to align.

THIS IS WHAT HAP
LET OUR CUSTOMERS

This is not exactly your typical dot matrix printer. But then, the ALPS Allegro 24 wasn't built in typical dot matrix printer fashion.

It's the result of a highly sophisticated new design process, never before attempted by any other printer company. We call it "Giving the Customers What They Want."
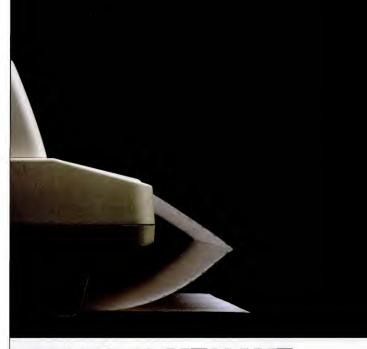
You told us you wanted a

rugged 24-pin printer for under $500. Which the Allegro 24 is. You wanted it to churn out page after page of crisp, letter-quality output. Which it does. And you wanted it with easy-to-use front panel controls. Which, of course, it has.

Then you insisted that it be jam-proof. Which explains this printer's uncharacteristic profile. You see, it has no platen. Just a unique flatbed design for a

PENED WHEN WE DESIGN A PRINTER.

paper path that's straight, direct and virtually unjammable.

As if that weren't enough, you asked for — and got — features like "paper parking," for automatic switching from fan-fold to single sheet feed. Four resident type fonts. And full compatibility with most all the PCs and software you already have.

For a free demonstration of the printer you've always wanted, see your local ALPS dealer. Or direct your questions, comments

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And help us design our next printer.

ALPS
AMERICA

Built by popular demand.

helpful for training users and debugging programs.

PC/NOS is Corvus's original *Omninet* rewritten into a bona fide contender in the network OS game. It gives the network manager easy installation (PC LAN Labs' experience notwithstanding), ample security levels, and flexible connections. It also gives the user simple messaging, low memory overhead, and solid performance.—M. Keith Thompson

TOPS/DOS

We have always liked TOPS. Though this network operating system is superficially simple, it remains part of a family of products with great flexibility. This flexibility has just been significantly improved by the release of *TOPS/DOS*, Version 2.1. The big news about Version 2.1 of *TOPS* is the addition of NetBIOS services and drivers for 3Com's EtherLink II and EtherLink/MC network interface cards.

The TOPS family of networking products spans computer systems based on Unix, DOS, and Apple operating systems. TOPS has always been a great way to link these otherwise dissimilar computers over the Apple's LocalTalk network card and

The TOPS/PC network adapter cards handle output for Apple's LocalTalk network. We used the Farallon computing adaptation of LocalTalk; the Farallon connectors extend LocalTalk through twisted-pair telephone wire. We also ran TOPS/DOS with new drivers that were supplied by 3Com's EtherLink II adapter cards.

cabling system. One popular use of the network systems is to make it easy for PC-based applications to use an Apple LaserWriter over LocalTalk.

While the LocalTalk card and cabling scheme is simple to install and fast enough for many applications, it is slow relative to other networking schemes and isn't widely used in the networking world. Since special versions of *TOPS* can run on Sun workstations and on other minicomputers running Unix, some network connection to these computers was needed. All of these problems disappear under *TOPS/DOS* 2.1 because Ethernet is so widely accepted and supported in the network marketplace.

The addition of NetBIOS services makes it much easier to add gateways, certain electronic mail, database, and spreadsheet programs, as well as other utilities to the network. The greater speed of Ethernet makes it more practical to run these services on the network.

NOT SO LOW-COST Under either LocalTalk or Ethernet, *TOPS/DOS* isn't an extremely low-cost networking alterna-

tive. The software costs $189 per node. The TOPS FlashTalk cards cost $239 each, and there's usually an additional charge per node for the adapters needed to connect the cards to twisted-pair wiring. Ethernet adapter cards retail for approximately $395 each, so while *TOPS/DOS* isn't necessarily a low-cost solution compared with the other systems reviewed here, it is a popular and flexible one that can expand with your needs.

Any station on a TOPS network can function as a server and make its resources available to the rest of the network. In a TOPS LAN populated by Apple, SUN, and IBM-compatible computers, this means that any of the machines can act as a file server for the others. It doesn't mean that these machines with different architectures can automatically use each other's data files, but there are many utilities and common file formats between these machines that make file sharing possible with careful planning. *TOPS/DOS*, for instance, includes a copy utility called TCOPY that lets you copy the contents of a DOS, Macintosh, or Unix directory across the network.

FAMILIAR INTERFACE The latest release of TOPS keeps the TOPSMENU interface for end users. This menu lets you decide if a directory or subdirectory will be made available for sharing through the network, along with how any available drives and printers will be addressed through your station.

Many network administrators will bypass the menus and take advantage of the command-line interface, which accepts typed commands or those entered through batch files. One of the nicest commands in the TOPS repertoire is TOPS UNLOAD. This command removes the memory-resident modules of *TOPS* from RAM.

> **TOPS UNLOAD** removes the resident modules from RAM; since they take about 192K, it's nice to reclaim this RAM when the network isn't in use.

Since these modules take about 192K of RAM, it is nice to be able to reclaim this sizable chunk of memory when the network isn't in use.

Another feature retained by the latest release of *TOPS*—albeit stubbornly—is its serial number scheme. Each copy of the software has a unique serial number, and each node must have a unique serial number to communicate. Unfortunately, this setup has the potential of being a headache for any network administrator trying to keep serial numbers straight when people are exchanging floppy disks and network files.

The *TOPS/DOS* security system uses a simple password scheme. Passwords can be assigned by the system administrator to resources like subdirectories to limit access. Similarly, the printer-sharing system is simple but effective. Printers on a PC can be shared only by other PCs, but Apple printers and some other categories of print-

ers can be shared across the network.

TOPS/DOS 2.1 is appealing in its simplicity and reliability. It lacks some of the administrative features found in other networking products and it doesn't exactly qualify as inexpensive, but it is flexible and powerful and can be the perfect solution for people with multivendor networking problems.—Frank J. Derfler, Jr.

ViaNet

Western Digital's *ViaNet* is a fully distributed peer-to-peer network operating system. Although *ViaNet* has been around since 1982, the product was acquired 2 years ago by Western Digital. The software costs $99 per node and can address a variety of interface cards. A version of *ViaNet* for Unix is also available.

For this low-cost LAN review we used *ViaNet* with Western Digital StarLink cards, which are rated at 1 megabit per second and with real throughput of 0.8Mbps. *ViaNet* is a shared-resource environment with no dedicated server. Each computer can share any of its resources through the

network. But *ViaNet* offers no "workstation-only" configuration that uses less RAM. Any node acting as a print server will use an additional 10K.

ViaNet is marketed in different packages through various channels, and the retail version sold through distribution is packaged in one of two ways. Each package comes with a "Super Disk" containing drivers for the most popular networks, including Novell's. The *ViaNet* starter kit includes three StarLink Plus cards, three copies of *ViaNet*, and the necessary plug-and-click cabling for $1,099. Each additional node costs $99 for the software plus $334 for the StarLink Plus card.

Another way to obtain *ViaNet* is through one of Western Digital's OEMs. *ViaNet*'s modular design allows OEMs to customize it to work with their particular cards. This gives them the ability to offer specific, more-complete solutions.

READY TO INSTALL Western Digital's StarLink cards come ready to install in most computers, with the selection of the IRQ line being the only potential change to the card. The installation pro-

We ran ViaNet over Western Digital's StarLAN adapter cards, one of a variety that the software can address. The Western Digital adapters can either hook together in daisy-chain fashion or connect individually to a StarLAN hub.

gram on the two-disk set is quick and easy. It creates the necessary subdirectories and modifies the CONFIG.SYS and AUTO-EXEC.BAT files. One thing that the program doesn't do is ask you what devices you would like to share. The default is to share floppy disk drives—requiring the network manager to edit the AC-CESS.SYS file to avoid problems.

We had a problem running *ViaNet* on our 20-MHz Compaq 386. Our benchmark-test software received an error message when trying to access a file immediately after creating it. When given the opportunity to retry, *ViaNet* responded properly. One thing *ViaNet* could use, however, is a disk-caching utility. Its performance didn't burn up the track, and a disk cache would help significantly.

ACCESSING DEVICES Users familiar with DOS will quickly pick up on the syntax that *ViaNet* uses to access network devices. *ViaNet* assigns Z: to the network. Each node attached to the network is a subdirectory on the Z: drive, and each resource shared is a subdirectory in the node directory.

Western Digital realized that under this architecture pathnames could get extremely long and that some pre-DOS 2.0 applications don't recognize paths. As a result, the company came up with a handy fix called MACASGN. The MACASGN command substitutes drive letters for path

names. The \INVENTORY\FILES directory on drive C: of the accounting computer, for example, can be alternatively referred to as drive N:.

As for security, *ViaNet*'s features are simple yet effective. You can assign users to groups to quickly establish levels of access, and you can also change the attributes of files to prevent losing data.

ViaSpool is the print spooler included with *ViaNet*. This spooler allows the user to send print jobs to the print server but doesn't display the print queue. The network manager has the ability to see the print queue and to change the priority of the print jobs. TALK is *ViaNet*'s "rude" messaging program. It puts an incoming message in the middle of your screen even if you are in the middle of a program. TALK does not have any store-and-for-ward capabilities.

ViaNet is a proven network OS capable of meeting most users' needs. The program isn't a top performer, but it is nevertheless reliable and inexpensive.

—M. Keith Thompson

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The Rack. It's 8 straight hours of burn-in testing. Yet only one of many trials every Hayes modem must go through before it's packed and shipped.

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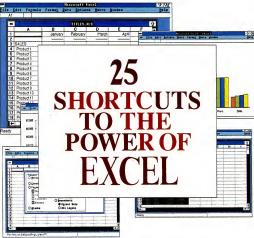
And we intend to let nothing lower those standards. Especially one of our own modems.

25 SHORTCUTS TO THE POWER OF EXCEL

*Like a work of modern art,
Microsoft Excel is easy to admire but
slightly harder to understand.
These 25 tips will help you cut through
the confusion and master
some of Excel's trickier commands.*

● *Microsoft Excel* is the most powerful spreadsheet on the market today. As *PC Magazine* wrote in its first review of *Excel* ("A New Face for Spreadsheets," December 22, 1987), the program is simply stuffed with features. Unfortunately, because of the depth and complexity of the program, it can take months to master *Excel's* advanced features and even longer to discover all of its hidden powers.

In the course of our work with *Excel*, we've learned how to use it more efficiently. Based on our

experience, we've compiled a list of tips. These include techniques that save time and make *Excel* easier to use, as well as pointers to help avoid its pitfalls. Some of these tips are included in the *Excel* reference manual, but few people take the time to read that massive volume in its entirety.

Here are 25 of the most interesting tips we've picked up along the way. You're sure to find them useful because while learning to use *Excel* on a basic level is fairly easy, learning to take advantage of its power is much more difficult.

Tip #1: When you want to save a document in an alternative directory, use the Open... command to change the default directory before you issue the Save As... command.

Excel does not allow you to change the default directory (called the *current directory* in the *Excel* manual) when you are saving a document. If you want to save an *Excel* file in a directory other than the program's default directory, you must preface the name of the file that you type into the *Save worksheet as:* text box with the path to that alternative directory. Although this saves the file into the directory you specified, it does not automatically make that directory the default directory.

However, you can change the default directory *before* saving a document. That way, you won't have to type in an alternative path into the *Save worksheet as:* text box because *Excel* will look to that directory when you next issue the Save As... or Open... commands.

To change the default directory, pull down the File menu and select the Open... command. When you do this, *Excel* will reveal a dialog box like the one shown in Figure 1. Within this dialog box, the name of the default directory appears to the right of the *Directory is* prompt.

To change the default directory, double-click the name of that directory in the *Directories:* list box. If the name of the directory that you want to make the default is not listed, click the one that will lead *Excel* to it. When the next directory name is revealed, double-click either the name of the directory that you want (if it appears

Figure 1: *You can use this dialog box to change* Excel's *default directory.*

or the name of the directory that will lead *Excel* to the directory that you want to make the default (if its name doesn't appear).

Once the name of the directory that you want to make the default directory is listed to the right of the *Directory is* prompt, choose the Cancel button. This cancels the Open... command without opening a file and at the same time makes the directory whose name appears to the right of the *Directory is* prompt the default directory. If you subsequently issue the Save As... command, *Excel* will save the current document into this directory unless you specify otherwise.

Tip #2: Use the Paste Function... command to enter unfamiliar functions into an Excel worksheet.

Even if you've worked with *Excel* for a while, you may not be familiar with the syntax of all its many functions. The Paste Function... command on *Excel*'s Formula menu is an easy way of entering a function whose syntax you do not know.

When you issue the Paste... command,

Figure 2: *This dialog box lists all of* Excel's *built-in functions.*

Excel will display the dialog box shown in Figure 2. This dialog box lists all of *Excel*'s built-in functions. To enter one of these functions, simply choose it from the list and then choose OK.

If the Paste Arguments check box is turned off, *Excel* will type the function you selected onto the formula bar in the form =FUNCTION(), where FUNCTION is the name of the function you selected. For example, if you selected the PMT() function, *Excel* will type =PMT() onto the formula bar. After *Excel* types the function, it will position the insertion point between the two parentheses, ready for you to type in the arguments.

If the Paste Arguments check box is turned on, *Excel* will type placeholders for the arguments of the function that you choose between the parentheses and at the end of that function and will select the placeholder for the first argument. For example, if you selected the PMT() function while the Paste Arguments option was on, *Excel* would type

=PMT(rate,nper,pv,fv,type)

onto the formula bar, and select the word *rate*. At this point, you would simply replace the placeholders with the appropriate numbers, strings, formulas, or functions, then lock the function to the worksheet.

Tip #3: Use the Ctrl-Enter combination to enter a formula into more than one cell at a time.

When you want to enter copies of a formula or function into several adjacent cells, you probably enter the function into one cell, then use either the Copy..., Fill Right..., or Fill Down... commands to copy it into the other cells.

However, you can enter a formula or function into one cell and copy it into adjacent cells in one step. To do this, select the range of cells into which you want to enter copies of the formula or function. Then type the appropriate formula or function into the active cell. Finally, press Ctrl-Enter. When you do this, *Excel* will lock the formula that you typed into the active cell and enter copies of that formula into the other selected cells. For example, if B7

is the active cell, you would select cells B7:D7, type =SUM(B3:B5), then press Ctrl-Enter to enter the functions =SUM(B3:B5), =SUM(C3:C5), and =SUM(D3:D5) into cells B7, C7, and D7, respectively.

Tip #4: To replace a formula or function with its result, recalculate it after bringing it to the formula bar.

If you want to replace a formula or function with its result while you are in editing mode, there is an easier way than going through the time-consuming process of using the Copy... and Paste Special... commands. All you have to do is bring the formula or function you want to have replaced to the formula bar, press the Calc key (F9), then press Enter. When you press Calc, Excel will replace the formula or function on the formula bar with the current result of that formula or function. When you subsequently press Enter, Excel will lock that result into the worksheet, replacing the formula or function.

Tip #5: Use the Ctrl-<semicolon> and Ctrl-<colon> keys to enter the current date and time into a worksheet.

To enter the current date into a cell, simply select that cell and simultaneously press the Ctrl-<semicolon> keys. When you do this, Excel will type the current date onto the formula bar in m/d/yy form. When you press Enter, Excel will lock the serial date value of the current date (the number of days that have elapsed since December 31, 1899) into the active cell and assign that cell the m/d/yy format.

To enter the current time into a cell, simply select that cell and simultaneously press Ctrl-<colon>. When you do this, Excel will type the current time onto the formula bar in h:mm AM/PM form. When you press Enter, Excel will lock the serial value of the current time (a decimal value representing the time as a fraction of the 24-hour day) into the active cell, and assign that cell the h:mm AM/PM format. Remember another important Ctrl-key combination as well: Ctrl-<quotation

mark>, which copies into an empty cell the contents of the cell above it.

Tip #6: To copy a formula without altering its relative references, either convert it into a label or copy it from the formula bar.

When you use the Copy... and Paste... commands to make a copy of a formula Excel adjusts the references to match the location of the copy. For example, if you copy the formula =A1+A2 from cell A4 into cell C5, Excel will place the formula =C2+C3—not =A1+A2—into cell C5.

If for some reason you want to make an exact copy of the formula leaving the initial references intact, there are two easy

■ **To enter the current date into a cell, simply select that cell and simultaneously press the Ctrl-<semicolon> keys.**

ways that you can do it.

First, you can convert the formula into a label. To do this, bring the formula that you want to copy to the formula bar. Then delete the equal sign (=) from the beginning of it by pressing Home and then Del. Next, press Enter or click the Enter box. When you do this, Excel will replace the formula with the label form of that formula. For example, if cell A4 contained the formula =A1+A2 originally, it will contain the label A1+A2 at this point.

Once you've converted the formula into a label, you can copy it anywhere without having Excel change any references within it. Once you've made the copy, you should convert both the original label and the copy of it back into formulas. To do this, bring each one to the formula bar individually, press Home, type an equal sign (=), and press Enter.

Although this method is easier than

making each reference absolute, there's an even easier way to make an exact copy of a formula: copy it from the formula bar. To do this, bring the formula to the formula bar, select it, and issue the Copy... command. When you copy a formula from the formula bar, Excel does not alter any of the references within it—even those that are relative.

Tip #7: You can debug a formula by calculating portions of it on the formula bar.

If Excel returns an error value such as #VALUE!, #REF!, or #NUM! when you press Enter to lock a complex formula into a worksheet, you can pinpoint the problem-causing portion of the formula by recalculating selected portions of the formula while it is on the formula bar. To do this, simply select the portion of the formula that you want to calculate and press the Calc key. When you do this, Excel will recalculate the selected portion of the formula and replace that portion with its result. Once you locate the portion of the formula that is causing the problem, you should press Esc or click the Cancel box to end the edit, bring the original formula back to the formula bar, make the correction, and then press Enter or click on the Enter box.

Tip #8: You can select an item within a list box by typing its first letter.

Rather than using the scroll bar or box to bring into view the portion of a list that contains an item you want, you can simply type its first character. Since the items in any list box are always arranged in alphabetical order, this will take you to the section of the list containing items beginning with that character. At this point, you can find the item you want (if there is more than one item beginning with the character you've chosen in the list) by using the scroll bar or box, or by continuing to press the character key. Each time you press the key, you will select the next item in the list beginning with that character. If you press the key when the final item that begins

with that character is selected, *Excel* will go back to the first item in the list that begins with that character.

Tip #9: Use the Shift-Tab combination to move backwards through a dialog box.

As you probably know, the Tab key serves as a convenient way to move around within a dialog box. When you press this key, *Excel* activates the next object (list box, text box, check box, option box, or button) within the dialog box. For example, pressing the Tab key from within a dialog box where the Header text box is active would

Figure 3: *The Shift-Tab combination moves you backward within a dialog box.*

activate the Footer text box; pressing Tab again would activate the Left text box, and so forth, in sequence.

You can use the Shift-Tab combination to move in the opposite direction within a dialog box. When you press Shift-Tab, *Excel* activates the previous object in that box. For example, pressing Shift-Tab while the *Left* text box within the dialog box shown in Figure 3 is active will activate the Footer text box; pressing Shift-Tab again will activate the Header text box; and so forth.

Tip #10: Use the custom format ;;; to hide entries in a worksheet.

Unlike many other spreadsheet programs, *Excel* does not feature a built-in "hidden" format—one that suppresses the display of the entries in the cells you specify. However, you can create a custom format that

does. To hide the entry in a cell, select it, pull down the Format menu, select the Number... command, and type ;;; into the *Format* text box. As soon as you choose OK, the *Excel* program will add ;;; to its list of formats, close the *Format Number* dialog box, and assign that format to the selected cell.

The semicolon (;) is the character that divides one part of a custom format from the next and determines how (or whether) different kinds of data are displayed. The part to the left of the first semicolon controls the display of positive values; the part between the first and second semicolons controls the display of negative values; the part between the second and third semicolons controls the display of the value 0; and the part to the right of the third semicolon controls the display of text. Since nothing appears between the semicolons in the ;;; format, *Excel* will not display anything in the cells to which the format was assigned, no matter what they contain.

Although the ;;; format prevents entries from being displayed in the worksheet, it does not prevent the contents of those cells from being displayed on the formula bar when that particular cell is active. In order to prevent this from happening, you must select that cell, pull down the Format menu, select the Cell Protection... command, turn on the *Hidden* attribute, choose OK, pull down the Options menu, select the *Protect Document...* command, and choose OK again.

Tip #11: You can use your mouse to alter the width of more than one column at a time or the height of more than one row at a time.

Many *Excel* users think that they can adjust the width or height of only one column or row at a time with their mouse. However, besides using the Column Width... or Row Height... commands, you can also adjust the size of multiple columns or rows with your mouse.

To adjust the width of two or more columns at once with your mouse, select each of the columns in its entirety. To do this, simply drag across the letters that identify those columns. Then place your mouse pointer in the row of column letters at the

top of the worksheet (on the vertical line at the right edge of any one of the columns you selected) so that the pointer turns into a double-arrow shape. Drag to the left or right until the column is as wide or as narrow as you want, and then release the button on your mouse. Actually, this is the same process that you use to adjust the width of a single column. As you drag the mouse, only the width of the column whose right border you are dragging will change. As soon as you release the mouse button, however, *Excel* will set the width of all of the selected columns to the width of the one you were adjusting. You can use a similar technique to adjust the height of more than one row at a time with your mouse.

Although you will usually use these techniques to adjust the widths or heights of adjacent columns or rows, you can use them to adjust the widths or heights of non-adjacent columns. To accomplish this, all you have to do is select the nonadjacent columns or rows by holding down the Ctrl key as you click their letter or number. At that point *Excel* will change the width or height of all of the selected columns or rows when you use your mouse to alter the width or height of any one of the selected columns or rows.

Tip #12: Use the Goto key in combination with the Shift key to select large ranges.

Like most *Excel* users, you probably select ranges in your *Excel* worksheets by dragging your mouse. As long as the range that you want to select is fairly small, this method works well. However, selecting a large range by dragging your mouse is a slow process since *Excel* has to shift new rows and columns onto the screen one at a time.

Fortunately there are faster ways of selecting a large range. First, after activating the cell at one corner of the range you want to select, you can hold down the Shift key as you click on the cell in the opposite corner. When you do this, *Excel* will select the rectangular range that has those two cells in opposite corners. For example, to select cells A1:AA100, you would activate cell A1, use the scroll bars to bring cell

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AA100 into view, hold down the Shift key, and click on that cell.

If you know the address of the opposite corner of the range you want to select,

■ Selecting a large range by dragging your mouse is a slow process since *Excel* shifts new rows and columns onto the screen one at a time.

there is an even easier way to select a large range: first activate the cell in one corner of the range. Then press the Goto key (F5) and type the address of the opposite corner of the range. Finally, instead of simply pressing or clicking OK to complete the Goto... command, hold down the Shift key while you do either of those things. When you do this, *Excel* will select the rectangular range that has the active cell in one corner and the cell whose address you entered into the *Goto* dialog box in the opposite corner.

Tip #13: Exclude title rows and columns from the print area.

When you specify the title columns and/or rows to be printed, you should specify a print range that does not include those columns or rows. Otherwise the contents of the title rows and columns will be printed twice on some pages of the report. To specify title columns and rows, you must select those columns and rows in their entirety, pull down the Options menu, and select the Set Print Titles... command. To exclude the title row and columns, select the range that you want to print, making sure that it does not include any cells in the title columns or rows. Then pull down the Options menu and select the Set Print Area... command.

For example, a correct printout is shown in Figure 4. Figure 5 shows how the

Figure 4: Setting print titles for a worksheet like this one produces a correct printout.

	January	February
	January	February
SALES	SALES		
Product 1	Product 1	$76,125	$79,931
Product 2	Product 2	$44,867	$47,110
Product 3	Product 3	$63,251	$66,413
Product 4	Product 4	$14,033	$14,734
Product 5	Product 5	$39,645	$41,627
Product 6	Product 6	$79,416	$83,386
Product 7	Product 7	$70,983	$74,532
Product 8	Product 8	$49,003	$51,453

Figure 5: Neglecting to exclude the title rows and columns from the print area causes them to be printed twice. It's an easily avoidable glitch.

	January	February	March
SALES			
Product 1	$76,125	$79,931	$83,927
Product 2	$44,867	$47,110	$49,465
Product 3	$63,251	$66,413	$69,733
Product 4	$14,033	$14,734	$15,470
Product 5	$39,645	$41,627	$43,708
Product 6	$79,416	$83,386	$87,555
Product 7	$70,983	$74,532	$78,258
Product 8	$49,003	$51,453	$54,025

Figure 6: All you need to do is exclude the title rows and columns from the print area. This prevents them from appearing twice in the printout.

first page of that printout would look if you set column A as a title column and rows 1 and 2 as title rows without setting a print area. As you can see, the entries in column A and rows 1 and 2 appear twice on the page. Figure 6 shows the first page after we used the Set Print Area... command to specify B3:N32 as the print area. The title columns and rows appear only once in the printed worksheet.

Tip #14: Use the Select Special... command to locate the cells that are dependent on or precedent to a formula or function.

When you are debugging a worksheet, you'll often want to know which cells contain formulas that are affected by the entry in a certain cell (the cells that are *depen-*

Figure 7: The Precedents option in this dialog box instructs Excel to select the cells that contribute to the result of the formula in the active cell. The Dependents option selects cells that contain formulas affected by the value of the active cell.

dent upon that cell), and which cells contain entries that affect the entry in that cell (the cells that are precedent to that cell). You can use the Select Special... command to identify these cells.

To find all the cells that are precedent to or dependent on a particular cell, select that cell, pull down the Formula menu, and select the Select Special... command. When you do this, Excel will display the dialog box shown in Figure 7. If you choose the Precedents option, then choose

If you choose the Dependents option, then choose OK, Excel will select the cells that contain formulas or functions that are affected by the value in the active cell.

If you select the Direct Only option, Excel will select only cells whose formulas and functions contain direct references to the active cell. And if you select the All Levels option, Excel will also select cells whose formulas and functions reference cells that directly reference the active cell, and so forth.

■ To find all the cells that are precedent to or dependent on a particular cell, select that cell, pull down the Formula menu, and choose Select Special.

OK, Excel will select the cells that contribute to the result of the formula in the active cell. If the Direct Only option is selected, Excel will select only those cells that are referenced directly by the formula or function in the active cell. If you select the All Levels option, Excel will also select the cells that are referenced by the formulas in the cells that are referenced by the formulas in the active cell, and so forth.

Tip #15: If you close a worksheet from which you have copied a formula before pasting it into another worksheet, Excel will paste the result of the formula, rather than the formula itself.

When you want to copy a formula or function from one worksheet into another worksheet, you select the cell that contains that formula, pull down the Edit menu, and select the Copy... command. Then you activate the worksheet that you want to copy the formula into, select the destination cell, pull down the Edit menu, and select the Paste... command.

If the worksheet that you copied the formula from is still open when you issue the Paste... command, Excel will place a copy of that formula into the appropriate cell of the destination worksheet. If you close the source worksheet before you issue the Paste... command, however, Excel will place the result of the formula into the destination sheet—just as if you had issued the Paste Special... command and specified the Values option.

Tip #16: Use the Row Height... command in conjunction with the Border... command to draw lines of varying thicknesses.

The Border... command on the Format menu allows you to draw thin lines at the left, right, top, bottom, or all edges of a cell. Although Excel does not have a command that increases the thickness of a line, you can create lines of practically any thickness that you wish. To do this, use the Border... command to draw lines at the bottom or top of two or more adjacent cells in a single column. The more cells you use, the thicker the line will be. Then select at least one cell in each of the rows in which you have drawn lines, pull down the Format menu, select the Row Height... command, type 1 into the Row Height text box, and choose OK. This pushes the lines at the bottom of each cell together, creating a thick line.

For example, suppose you want to draw a heavy line in columns B through G at the top of a new worksheet. Begin by selecting cells B2:G4, pulling down the Format menu, selecting the Border... command, choosing Bottom, and then choosing OK. This creates three thin lines: one at the bottom of cells B2:G2, another at the bottom of cells B3:G3, and a third at the bottom of cells B4:G4.

After creating these lines, select at least one cell in each of rows 2, 3, and 4, pull down the Format menu again, select the Row Height... command, type 1 into the Row Height text box, and choose OK. Note that Excel has decreased the height of rows 2, 3, and 4 to that of one row. This pushes the lines at the bottom of cells B2:G2, B3:G3, and B4:G4 up against each other, creating a single line that is three times as thick as any of the individual lines.

Tip #17: Save memory by using array formulas instead of multiple copies of regular formulas.

When you need to perform the same calculation on a number of values in adjacent cells of a single column or row, you probably enter a formula or function into one

cell, then use the Copy... or Fill Down... command to copy it down or across into the other cells. However, you can save some of your memory by using an array formula.

For example, suppose you want to enter formulas into cells B2:B11 that calculate the square roots of the values in cells A2:A11. To do this, you would select cells B2:B11, type the formula SQRT (A2:A11)), and press Ctrl-Shift-Enter. This process assigns the array formula

$$\{=SQRT(A2:A11)\}$$

to the range B2:B11. This single formula commands Excel to calculate the square root of each of the values in cells A2:A11 and enter the results—the same results that individual =SQRT functions would return—into cells B2:B11.

Tip #18: Use multiple sequential sorts to sort a database on more than three fields.

Excel contains commands for only three sort fields in its Sort dialog box. However, that doesn't prohibit you from sorting the information in a worksheet on more fields than that. To sort a database on the basis of the

> ■ Excel contains boxes for three sort fields in its Sort dialog box, but that doesn't prohibit you from sorting the information on more fields than that.

entries in more than three fields, you must perform two or more sorts.

The trick is that these sorts must be performed in a peculiar order. For example, to sort a database on the basis of the entries in four fields, you would first perform a

Figure 8: To sort this database on the basis of the entries in all four fields, you must perform two sorts.

Figure 9: To sort the database into this order, first sort it on the basis of the entries in the Color, Shape, and Size fields, then sort it on the basis of the entries in the Part field.

three-field sort that specifies the secondary field as the first key, the tertiary field as the second key, and the quaternary field as the third key. Then you would perform a single-field sort that specifies the primary field as the only sort key.

To demonstrate this technique, suppose that you want to perform a four-field ascending sort on the database shown in Figure 8, with Part as the primary field, Color as the secondary field, Shape as the tertiary field, and Size as the quaternary field. To do this, you would select cells B2:D17, pull down the Data menu, select the Sort... command, specify any cell in column B as the 1st key, specify any cell in column C as the 2nd key, and any cell in column D as the 3rd key. Then, after choosing OK to perform this sort, you would reissue the Sort... command, this time specifying any

cell in column A as the primary sort field, and leaving the 2nd Key and 3rd Key boxes blank. Figure 9 shows the results of these two sorts.

Tip #19: Always use the Data Extract... command before you use the Data Delete... command.

The Delete... command on Excel's Data menu deletes all of the criterion-matching records from a database. Before you use this powerful command, it's a good idea to use the Extract... command to make a copy of the records that Excel will subsequently delete. That way you can see which records are slated for deletion before they vanish. This precaution also makes it easy to replace any of the deleted

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records after they've been removed from the database.

To extract all of the criterion-matching records from a database, copy the field names from the top of the database to a blank portion of the worksheet. Then select the cells into which you copied those names (and, if you wish, the cells in at least as many rows below them as there are criterion-matching records in the database). Finally, pull down the Data menu, select the Extract... command, make sure that the *Unique Records Only* check box is off, and choose OK.

As soon as you do this, *Excel* will place a copy of every criterion-matching record into the cells below the copies of the field names. If the records that *Excel* selects are the ones that you want to delete, you can pull down the Data menu and select the Delete... command at that point. If the records that *Excel* selects are not the ones that you want to delete, you should alter the selection criteria and reissue the Extract... command. Once you find the criteria that causes *Excel* to select the records that you want to delete, you can issue the Data Delete... command. If you later want to replace some of the deleted records, you can do so simply by copying them from the extract range back into the database.

Tip #20: If you issue the Data Extract... command while only the row of field names is selected, *Excel* will erase all of the cells below the ones that contain those names.

As we explained in the previous tip, the Data Extract... command makes a copy of all of the criterion-matching records in an *Excel* database. To use this command, you start by copying one or more of the field names from the database into a group of adjacent cells in a single row. Then you select the cells that contain the field names and, if you wish, the cells in one or more rows below those cells as well. Next you pull down the Data menu, select the Extract... command, and choose OK.

What happens when you issue the Data Extract... command depends on the size of the range that you selected. If you selected a multiple-row range, *Excel* will clear the entries from all of the cells in that range

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(except the ones that contain the field names). Then it will copy as many of the criterion-matching records from the database as will fit into that range. If the extract range is too small to hold all of the criterion-matching records, *Excel* will copy as many as will fit, then display an alert box

■ The Data Extract… command makes a copy of all of the criterion-matching records in an *Excel* database.

that contains the message "Extract range is full."

If you selected only the row of field names before issuing the Data Extract… command, *Excel* will clear the entries from all of the cells below the ones that contain the field names—all the way to the bottom of the worksheet! Then it will copy the criterion-matching records into those cells.

Specifying a single-row extract range virtually ensures that *Excel* will be able to extract all of the criterion-matching records from the database. However, it runs the risk of erasing entries that you don't want to erase. To avoid losing information, make sure that all of the cells below the field names at the top of the extract range are empty before you issue the Extract… command while only the field names are selected.

Tip #21: The Paste Special… command lets you control the way that *Excel* interprets a range of data when it creates a chart.

When you command *Excel* to create a chart (by selecting a range of entries, pulling down the File menu, selecting the New… command, choosing the Chart option, and then choosing OK), it assumes that you want the chart to contain more categories than data series. For this reason, using the above method to create a chart

Figure 10: *When you command Excel to create a chart, it assumes that you want the chart to contain more categories than data series.*

Figure 11: *This is the default chart that Excel created from the entries in cells A3:E8 of the worksheet shown in Figure 10.*
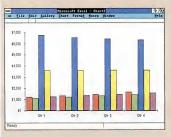
Figure 12: *To create this chart, you must use the Rows option of the Paste Special… command.*

WHEN A HARD
YOU ONLY HAVE

DISCARD IT.

may not always produce the results you want.

For example, suppose that you want to produce the chart from the information in cells A3:E8 of the worksheet shown in Figure 10. If you select the cells and use the Copy... command from the File menu, Excel will create the chart shown in Figure 11, since the range you selected is taller than it is wide.

To create a chart that has fewer categories than data series, you can create a blank chart document, then use the Copy... and

■ If the category axis of a chart contains too many categories, the labels will not fit on a single line.

Paste Special... commands to supply information for the chart. The Rows and Columns options within the dialog box that appears when you select the Paste Special... command from the Edit menu of a chart document allow you to control the way that Excel divides a range of data into categories and data series. If you choose the Rows option, Excel will treat each row as a series and each column as a category—no matter how tall or wide the range is. If you choose the Columns option, Excel will treat each column as a data series and each row as a category.

For example, to create the chart shown in Figure 12, you create an empty chart by issuing the File New Chart... command while nothing is selected in the worksheet document. Then you activate the worksheet document, select cells A3:E8, pull down the Edit menu, and select the Copy... command. Next, you reactivate the chart document, pull down the Edit menu, and select the Paste Special... command. Since you want each row to be a data series, you would choose the Rows option in the Paste Special dialog box. When you choose OK, Excel will display the chart shown in Figure 12.

Tip #22: If the labels on the category axis of a chart are too tight, use the Format Scale... command to specify a skip factor.

If the category axis of a chart contains too many categories, the labels of all of those categories will not fit on a single line. Consequently, Excel will divide those labels onto two or more lines. As you can see if you try it, this effect is not very attractive.

You can improve the appearance of a chart of this sort by commanding Excel to display the labels for fewer categories. To do this, select the category axis by clicking on it. Then pull down the "Format" menu and select the Scale... command. As soon as you issue this command, Excel will reveal a dialog box like the one that is shown

in Figure 13 for you to set up.

The *Number of Categories Between Tick Labels:* text box within this dialog box allows you to specify the skip factor for the labels on the category axis, with the following results: the number 1 in this box commands Excel to display a label below each category; the number 2 commands it to display a label for every other category; the number 3 commands it to display a label for every third category; and so forth. To change the number, double-click it, type a new number, and choose OK.

Figure 14 shows the result of entering the number 2 into the *Number of Categories Between Tick Labels:* box for the original chart. As you can see, Excel displays a label for every other category in the chart, instead of every one. Consequently the labels fit on a single line.

Figure 13: The Number of Categories Between Tick Labels: text box allows you to specify the skip factor for the labels on the category axis.

Figure 14: This chart shows the result of specifying a skip factor of 2 for the chart shown in Figure 13.

Tip #23: Hide your macro sheets to keep them from cluttering up your workspace.

To keep your *Excel* macro sheets from cluttering up your workspace, you can hide them. To hide a macro sheet, simply make it the active document, pull down the Window... menu, and select the Hide... command. As soon as you do this, *Excel* will hide the macro sheet. However, the macro sheet will remain in RAM. Consequently you can still invoke the macros that are stored in that sheet.

If you wish, you can save your macro sheets in hidden form. That way, you won't have to issue the Hide... command each time you retrieve a macro sheet. Since a hidden document cannot be the active document, you can't use the Save... or Save As... commands to save the macro sheet. Instead, you must follow these

> ■ If you wish, you can
> save your macro sheets
> in hidden form. That
> way, you won't have to
> issue the Hide...
> command each time you
> retrieve a macro sheet.

steps: First, open the macro sheet and make at least one change to it, such as making an entry and then erasing it. Next hide the macro sheet by pulling down the Window menu and selecting the Hide... command. Third, pull down the File menu and select the Exit... command. When *Excel* asks you whether you want to save the changes that you made to the macro sheet, choose Yes. Since the macro sheet will be hidden when *Excel* saves it, it will be saved in hidden form. When you next open the macro sheet, *Excel* will load it into RAM without making it visible on the workspace.

To resave the macro sheet in visible form, use the Unhide... command on the Window menu or the Unhide Window... command on the File menu to unhide the sheet, make a change to it, and then issue the Save... command.

Tip #24: Use two simple statements to return the active cell to its original position after the execution of a macro.

After *Excel* completes the execution of many command macros, the cell that was active before you ran the macro may not be active anymore. If you want the same cell to be selected after the execution of a macro as was selected before, begin the macro with the function

```
=DEFINE.NAME("Here")
```

This function assigns the name *Here* to the cell that is active when you invoke the macro. Then, end the macro with the following function:

```
=FORMULA.GOTO(!Here)
```

This function makes the cell named *Here* (the cell that was active when the macro began) the active cell once again.

Tip #25: Create user-defined functions for repetitive calculations.

Although *Excel* features a multitude of built-in functions, it may not have the ones that perform all the calculations you use on a regular basis. Rather than entering a complex formula each time you need to perform a calculation for which there is no built-in function, you can create a user-defined function.

A user-defined function is a special macro that performs a calculation and returns a result. The first cell of any user-defined function should contain the name of the function. The next cell(s) should contain ARGUMENT() function(s) that name the argument(s) of the user-defined function. The following cell should contain a formula that performs a calculation based on the argument(s) of the user-defined

function. The final cell should contain a RETURN() function that passes the result of the calculation back to the worksheet.

For example, suppose that you often needed to truncate (not round) a value to a particular number of digits to the right or left of the decimal point. To do this, you could use the user-defined function

```
TRUNCATE
=ARGUMENT("Number")
=ARGUMENT("Digits")
=INT(Number*10^Digits)/10^Digits
=RETURN(A4)
```

The first cell of this macro contains the label TRUNCATE—the name of the function. The second cell contains the function =ARGUMENT("Number"), which assigns the number specified by the first argument of the function to the variable named *Number*. The third cell contains the function =ARGUMENT("Digits"), which assigns the number specified by the second argument of the function to the variable named *Digits*.

The fourth cell contains the formula

```
=INT(Number*10^Digits)/10^Digits
```

which truncates the number specified by the first argument at the number of digits to the right or left of the decimal point specified by the second argument. The final cell of the macro contains the function =RETURN(A4), which instructs *Excel* to display the result of the previous calculation in the cell that contains the function.

As an example of the use of this function, suppose that cell A1 contains the number 123.456. To truncate this number after the second digit to the right of the decimal point, you would use the function

```
=UDF1.XLM!TRUNCATE(A1,2)
```

When *Excel* evaluates this function, it would assign the number 123.456 to the variable *Number* and assign the number 2 to the variable *Digits*. Then it would calculate the formula in cell A4 and display the result (the number 123.45) in the cell that contains the function. ▣

Douglas Cobb and Steven Cobb are contributing editors of PC Magazine. *They edit the Spreadsheet Clinic in each issue.*

Tandy Takes the Plunge into MICRO CHANNEL

At long last, Tandy emerges with the first Micro Channel-compatible to hit the market: the Tandy 5000 MC.

Two long years ago, pundits promised that the first compatible computers using IBM's then newly introduced Micro Channel Architecture would be available in as little as 6 months—9 on the outside. A year after the MCA introduction, at the spring 1988 Comdex, companies revealed the first of these products—prototype computers-along with chip sets to make the cloning easier and

unbridled enthusiasm on the part of potential Micro Channel cloners.

Then nothing. Promised PCs never materialized. Manufacturers withdrew from the market and redrew their plans. The bright future of the Micro Channel turned turbid with speculation about expensive licensing, doubtful benefits, a disbelieving marketplace, and even the introduction of a new, non-IBM standard for the next generation of high-performance computers—EISA, Extended Industry Standard Architecture, a 32-bit extrapolation of the "classic" AT bus that included many of the features of the Micro Channel but was not compatible with it.

This new threat to the imperiled IBM brainchild sparked a resurgence of promotion of the Micro Channel by its creator,

and the company pulled out all stops to show the advantages of the new architecture at last fall's Comdex. At IBM the move is on to ensure that the Micro Channel is the next industrywide PC standard. But the company's efforts will come to naught should other computer makers refuse to adopt the Micro Channel and make machines that follow that standard. In other words, the success of the Micro Channel depends on the efforts of independent computer makers.

Could the fate of the Micro Channel depend on this one machine, the Tandy 5000 MC? Since the Tandy is the first Micro Channel–compatible computer to be shipped in America by any manufacturer other than IBM, its sales will help determine the acceptance of third-party Micro

Channel machines. But the Tandy 5000 MC won't be the only Micro Channel standard-bearer for long. Even Tandy doesn't believe that the 5000 MC by itself will make or break the Micro Channel. However, the success of the 5000 MC and that of other upcoming Micro Channel compatibles will decide the complexion of the personal computer industry for years to come.

At minimum, the 5000 MC will help set the pace for the rest of the industry and may just be a harbinger for major changes in our concept of what constitutes a compatible computer. It's the first machine to hint that the classic clone may be a thing of the past—commodity computers may give way to individualistic efforts, each with its own novel twists to performance, features, and convenience. The massive price breaks we now take for granted from clone manufacturers may also fade from sight as Big Blue tightens the belts of its patent licensees.

Much has been made of IBM's April 1988 decision to collect retroactive royalties on past sales of PC, XT, and AT clones from compatibles manufacturers seeking licenses to produce Micro Channel clones. Undoubtedly IBM's crippling ceiling of 5 percent could make the production of Micro Channel clones unprofitable for manufacturers, but it's difficult to gauge the degree to which IBM is enforcing its own edict.

Examined as simply another 80386-based computer, the 5000 MC seems expensive, even when compared with other machines in the Tandy line. Its base price is $1,000 more than that of the Tandy 4000 LX, a machine that delivers similar performance (its 80386 operates at the same 20-MHz speed as the 5000 MC) but lacks the Micro Channel bus. That price difference covers more than the added costs of the Micro Channel design, however. For instance, the 5000 MC also includes built-in system-board VGA graphics and a different memory design.

The official Tandy policy line is that the 5000 MC is priced in accordance with the additional value it offers.

"We don't compete just on price but also on the end-user value that we offer," said Tandy's Howard Elias.

Part of the difference in price between

Tandy 5000 MC vs. IBM PS/2 Model 70-121 and Tandy 4000 LX: Summary of Features

(Products listed in ascending price order)

BASIC CONFIGURATION	Tandy 4000 LX	Tandy 5000 MC	IBM PS/2 Model 70-121
List price	$3,999	$4,999	$7,995
RAM	2MB	2MB	2MB
Floppy disk drives	One 1.44MB 3½-inch	One 1.44MB 3½-inch	One 1.44MB 3½-inch
Hard disk drive	None	None	120MB
Software included	Setup, diagnostics	Setup, diagnostics	Setup, diagnostics, disk cache
On-board video adapter	None	VGA	VGA
Ports	One serial, one parallel	One serial, one parallel, one mouse	One serial, one parallel, one mouse
Slots	One 32-bit, six 16-bit, two 8-bit (all AT-standard)	Two 32-bit, three 16-bit (all MCA)	Two 32-bit, one 16-bit (all MCA)
SPECIFICATIONS			
Clock speed	20 MHz	20 MHz	20 MHz
Maximum RAM on motherboard	2MB	2MB	6MB
Maximum 32-bit RAM	16MB	16MB	16MB
Math coprocessor supported	80387, Weitek 3167	80387, Weitek 3167	80387
RAM chips	DRAM	DRAM	DRAM
OTHER			
Warranty	1 year	1 year	1 year
FCC certification class	A	A	B

Tandy's 20-MHz 386 offerings could be traced to the cost of licensing IBM's Micro Channel technology. Neither Tandy, IBM, nor other MCA manufacturers will speak about licensing specifics, so the exact toll levied for the technology cannot be determined. The only comment that Tandy offered as to its use of IBM's technology is that such use is licensed.

"We have a cross-licensing agreement with IBM on all computer products that we manufacture," explained Elias, who would not elaborate further.

According to another manufacturer, however, the Micro Channel currently does not add to the cost of licensing IBM's computer patents.
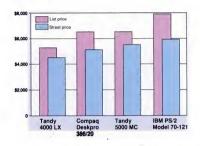
"At this time there are no present royalties due on Micro Channel architecture, although that is subject to change once patents are issued," said Dave Kirkey of American Logic Research, which has been licensed to use IBM technology. ("We presently have a patent license agreement in place with IBM that covers technology in the computer industry for a set period of time," Kirkey explained.)

That's not to say using IBM's technology is free. Existing IBM patents cover many design elements vital to personal computers, and the use of designs covered by those patents must be licensed. Whatever the cause, the result of Micro Channel politics is that the street price of Tandy's "clone" is roughly the same as that of IBM's PS/2 Model 70-121, making the Tandy machine's greater expansion possibilities perhaps the sole merit of choosing Tandy's Micro Channel computer over IBM's (see the sidebar, "Micro Channel on the Street"). The implications of this unique pricing situation on Tandy's sales remain to be seen.

That a computer from Tandy should play this pivotal role should not be unexpected. The company was second (by about 2 days) to announce, back in the spring of 1987, that it would offer a Micro Channel computer. The only things that are unexpected about the 5000 MC are its lengthy gestation and its difference from its direct Micro Channel ancestors. The Tandy 5000 MC is not so much a PS/2 clone as a good-performing desktop computer that just happens to take advantage of IBM's Micro Channel architecture.

MICRO CHANNEL ON THE STREET

Can Micro Channel clones underprice IBM on the open market?

As the first Micro Channel–compatible computer to hit the personal computer marketplace, the Tandy 5000 MC has a good number of tales to tell. Released amid a controversy over licensing fees for Micro Channel technology that for some companies may soar as high as 5 percent, the Tandy 5000 MC's price tag comes as no surprise. The base price of the 5000 MC is a full $1,000 more than that of Tandy's own 20-MHz 386 standard-bus computer, the Tandy 4000 LX.

But list prices don't tell the whole story. The prices reflected in the bar graph are for basic units with 2MB RAM, a 40MB hard disk, and without monitors or add-in video cards (where applicable). The IBM machine includes a 120MB hard disk, the smallest disk available with the Model 70-121. If the two Micro Channel PCs are judged on list price alone, it appears that the Tandy 5000 MC has the IBM PS/2 Model 70-121 beat. But if you discount the IBM at metropolitan rates and subtract 12.5 percent from Tandy's prices (Tandy regularly discounts at between 10 and 15 percent) it becomes clear that IBM emerges the winner, an unprecedented event in the world of clones. For only $263 extra, you can get the real McCoy from IBM and a far larger hard disk to boot.

If you're one to complain about IBM's expansion-cutting in the name of small footprint, however, turn to Tandy. The Tandy 5000 MC skimps on next to nothing, from expansion possibilities to performance. In the past, the word *clone* has meant big price breaks, and with those fewer dollars often came lesser quality and performance. Not so with Tandy, which, as the first Micro Channel clone producer, may set the stage for a new type of clone. While it's true that you won't be paying any extra for the original Micro Channel from IBM, for the first time you may not be getting any extra either, especially if your expansion needs are more than basic.
—**Stephanie K. Losee**

JUST AN ORDINARY FACE Aside from being the first MCA compatible, the Tandy 5000 MC fits into several classes. It's an 80386-based personal computer. Running at 20 MHz with enough of a memory cache to get it close to zero-wait-state operation, the $4,999 (base price without hard disk) machine has enough horsepower to run a small business or a corporate department. It's also a small-footprint computer that won't overrun a junior executive's desk. At the same time, the 5000 MC doesn't skimp on growth capabilities and holds the potential for con-

summate memory growth, mass-storage expansion, and an adequate number of expansion boards. It's the top of Tandy's current lineup. And it reflects the multitude of changes taking place in the personal computer industry today.
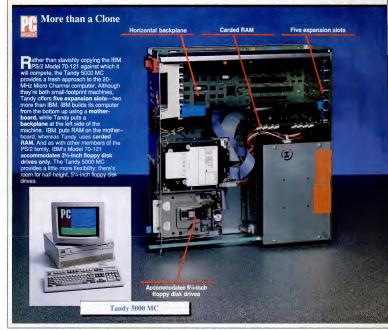
To look at the 5000 MC, you wouldn't think it was anything special. Its 6½- by 17- by 16-inch (HWD) case bears a distinct kinship to other Tandy products. So strong is the resemblance that you might suspect its mechanical components have merely been reworked from any of a number of earlier Tandy models, such as the

small-footprint 3000 series.

The likeness is hardly coincidental. Modifying standard parts helps a manufacturer field a new product while suffering smaller development costs, a wise business choice when the market for the product is unproven. As a result, the case of the 5000 MC is quite traditional in its design. Instead of the innovations of IBM's PS/2 designs aimed at lowering manufacturing costs, the 5000 MC is a machine crafted with modest development expenditures in mind.

For example, although only five Micro

More than a Clone

Rather than slavishly copying the IBM PS/2 Model 70-121 against which it will compete, the Tandy 5000 MC provides a fresh approach to the 20-MHz Micro Channel computer. Although they're both small-footprint machines, Tandy offers **five expansion slots**—two more than IBM. IBM builds its computer from the bottom up using a **motherboard,** while Tandy puts a **backplane** at the left side of the machine. IBM puts RAM on the motherboard, whereas Tandy uses **carded RAM.** And as with other members of the PS/2 family, IBM's Model 70-121 **accommodates 3½-inch floppy disk drives only.** The Tandy 5000 MC provides a little more flexibility; there's room for half-height, 5¼-inch floppy disk drives.

Horizontal backplane   Carded RAM   Five expansion slots

Accommodates 5¼-inch floppy disk drives

Tandy 5000 MC

Channel slots are available inside the 5000 MC, the back panel shows six shiny chrome retaining brackets. The extra is probably a result of hand-me-down engineering; the previous computer to use this cabinet had six slots. Another clue to this strategy is the connector linking the power supply to the system, a large Molex connector. Although it bears no resemblance to an IBM power connector, it is identical to those used in many other Tandy computer models and allows the 5000 MC to use an off-the-shelf Tandy power supply.

As with conventional AT compatibles,

the sheet-metal lid of the 5000 MC covers a U-shaped chassis, a trough that rises front and rear to hold various system assemblies. The front panel, which is attached to the lid, and a decorative snap-on back-panel cover that is part of the chassis are molded from color-coordinated plastic, all a pale white-beige. The case is gently rounded, a toning down of Tandy's previous Buck Rogers aesthetics, accented by the 2-inch swath of horizontal cooling slots that run the width of the front panel.

Despite the heavy-gauge metal of the case, at the time of this review the 5000

MC had earned only a Class A rating from the FCC, making the system suitable solely for business use. According to Tandy, the Class A rating was a matter of expediency to get the machine to the market without greater delay. The company is working on Class B certification. Numerous copper grounding fingers, used to assure the electrical connection of the chassis and lid of the case, attest to the seriousness of those efforts.

A minimum of controls adorn the front panel of the 5000 MC. A narrow system-reset button pokes through the case at the

Motherboard

Three expansion slots

Accommodates 3½-inch floppy disk drives only

IBM PS/2 Model 70-121

Some views on why the NEC MultiSync

There's a lot more to the new MultiSync® 3D monitor from NEC

than meets the eye. Because instead of making one monitor for each

graphics board, we've devel-

oped a monitor that enhances

Front

Back

the performance of the modes on

practically *any* board.

With its new microprocessor-controlled digital tuning system,

MultiSync 3D can adjust to a given video standard with a precision

matched only by a few high-end single-frequency monitors.

Making it perfectly compatible with virtually all systems and

boards. From 8514A, SuperVGA and Mac II to VGA, EGA, MDA and

far left. Behind the front panel, this button is actually an outgrowth of a large plastic molding, hinged at the top and reluctant enough to activate that you won't accidentally bump your programs into oblivion. Hiding invisibly behind the front panel nearby is a generous 2-inch speaker.

On the right is a similarly shaped green power push button with a built-in LED power indicator. This button is actually a lengthy plastic I-beam that runs from the front panel back to the power supply case, allowing Tandy to keep dangerous voltages safely within the chrome-plated confines of the power supply box while giving you convenient front panel power control.

A flat key switch just left of center at the top of the front panel locks the lid on the case but is electrically inactive, providing no keyboard-access control. That job is left to the password access routines built into the system BIOS.

The rear panel provides access to all connectors. Near the top-left corner of the back panel is the power input jack with a slide selector for 115- or 230-volt operation just below it. No switched power jack for connecting a display is available.

Running across the lower edge of the rear panel are the standard port connectors. From left to right you'll find the keyboard and mouse jacks, parallel and serial port connectors, and the VGA video output. The serial connector follows the AT standard, using a 9-pin male D-shell. The rest of the connectors match the PS/2 choices: 25-pin female D-shell for the parallel port, 15-pin high-density D-shell for VGA, and a miniature 6-pin DIN for keyboard and mouse.

At the far right are retaining brackets for the expansion slots of the 5000 MC. Telling the tale that these slots are special is the long knurled screw at the bottom of each one that allows you to remove the bracket (and presumably whatever card is attached to it) without the need for tools.

Only three screws secure the lid of the 5000 MC. When they are removed, the lid slides forward and off, revealing what appears to be an entirely conventional internal mechanical layout. At front right are the drive bays; at rear right, the 192-watt Tandy-made power supply. Expansion slots fill the left side, with the system board lining the chassis bottom.

Examine the system more closely, however, and a number of variations on the commonplace theme become apparent. The system board is oddly shaped and incomplete—major portions of the system electronics have been exiled to expansion boards. The drive bays, although conventionally welded to the chassis, have the potential to hold an unusual combination of drives.

REORGANIZATION PLAN The 5000 MC is in some respects a modular computer. While logically equivalent to other IBM-compatible machines, it does not use a single system board. Instead, the electronics of the 5000 MC comprise three principal assemblies: the main logic board, which includes expansion slots, floppy disk control, keyboard and pointing device support, serial and parallel ports, and video circuitry; the CPU (Central Processing Unit) board, which holds the microprocessor and related circuit elements; and memory boards.

The CPU board is about the same size as an AT expansion board and fits into a proprietary 32-bit connector near the left edge of the main logic board. Three 132-pin PGA (pin grid array) sockets on the CPU board hold the principal circuitry of the computer: its 80386-20 microprocessor, a matching 82385-20 cache controller, and the optional 80387-20 or Weitek 3167 numeric coprocessor. (Weitek support is anticipated, though not currently documented.)

The cache for the 82385 controller is also located on this board, comprising 16 soldered-down 16-kilobit static RAM chips rated at 35 nanoseconds. In addition, the CPU board includes the 40-MHz oscillator that's divided among the microprocessor clock and other system functions.

Normal system memory is all consigned to proprietary expansion boards in either or both of the two special slots provided at the side of the expansion board area, opposite the CPU board. Each short (about 5 inches) memory expansion board has sockets with a capacity for eight SIMMs (single in-line memory modules). Each one of these sockets must be filled with either 256-kilobit or 1-megabit SIMMs, and all modules in a given con-

Relative Times
(IBM PS/2 Model 70-121 = 100)

PROCESSOR AND MEMORY BENCHMARK TESTS

DISK BENCHMARK TESTS

VIDEO BENCHMARK TESTS

		PROCESSOR AND MEMORY BENCHMARK TESTS			DISK BENCHMARK TESTS			VIDEO BENCHMARK TESTS		
	NOP	80386 instruction Mix	Floating-Point Calculation	Conventional Memory	DOS File Access (small record)	DOS File Access (large record)	BIOS Disk Seek (milliseconds)	Video BIOS Routine Without Scrolling	Video BIOS Routine with Scrolling	Direct to Screen
IBM PS/2 Model 70-121	1.68	3.24	12.72	0.61	73.98	6.70	25.27	0.98	3.68	6.54
Tandy 4000 LX	1.68	3.24	12.86	0.60	71.03	6.78	30.59	0.76	2.70	4.17
Compaq Deskpro 386s	1.65	2.90	10.50	0.40	56.78	9.40	18.50	1.21	0.93	
Tandy 5000 MC	1.64	2.76	10.55	0.40	66.11	8.20	18.44	1.25	4.16	6.66

The **Conventional Memory** benchmark test allocates 256K of conventional memory and treats it as a series of 64-byte records. Then, 16,384 random records are read into and written from this memory. The result shown is the average of the read and write times.

The **DOS File Access** benchmark test measures the throughput rate of the disk being tested. In this case, throughput times are measured in terms of how long the disk takes to perform common DOS file management functions. Five tasks—file creation, sequential file write, sequential file read, random file write, and random file read—are timed and the results summed.

The test is carried out for two different types of files—small-record files and large-record files—that are used by common PC applications. Files created using small records are typically used by database management programs, and large records are typically used for word processing and spreadsheet files. Loading a DOS program is also simulated by the large-record test.

The **BIOS Disk Seek** benchmark test measures the time it takes to do a random seek using the disk's ROM BIOS. The test result includes minimal software overhead and may not parallel the manufacturer's claimed average access time. The test program performs 1,000 seeks. The average result is shown in milliseconds.

The **Video BIOS Routine Without Scrolling** benchmark test measures the speed of the BIOS Teletype routine without scrolling. The test is performed in video mode 3. The screen is cleared and 24 lines of 60 characters each (including a terminating carriage return and line feed) are written to the display through the BIOS Teletype routine. This is done ten times, and the result shown is the total of the ten trials.

The **Video BIOS Routine with Scrolling** benchmark test measures the speed of the BIOS Teletype routine with scrolling. The test is performed in video mode 3. The screen is cleared and 240 lines of 60 characters each (including a

terminating carriage return and line feed) are written to the display through the BIOS Teletype routine. Although the first 24 lines written to the display do not involve scrolling, all the remaining lines scroll the display.

The **Direct to Screen** benchmark test measures the bandwidth of the video adapter by writing directly to the display memory buffer. The test is performed in video mode 3. The entire screen is updated using the assembly language REP STOSW instruction with register CX equal to 2000. This is done 1,000 times, and the result shown is the total of the 1,000 trials.

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puter must be of the same capacity.

The standard-equipment memory of the 5000 MC is the minimum supported capacity, 2MB. In the evaluation machine, Tandy used modules with a 100-nanosecond speed rating. Adding a second board extends memory to 4MB. Eight or 16MB (the maximum physical memory that is addressable by the 5000 MC) total system capacity is possible with 1-megabit SIMMs.

In normal operation, the memory of the 5000 MC is logically divided to allow 640K for DOS, 384K for shadow RAM, and the balance in the extended addressing range. Buying the base system thus yields you 640K DOS and 1,024K extended memory.

The circuits on the main logic board include all input/output functions, with the connectors for the standard-equipment ports soldered directly to the board. In addition, the main logic board provides floppy disk control circuitry, the continuously running time-of-day clock, and CMOS setup memory—the last two in self-contained modules. Lithium battery power promising a 10-year minimum life is sealed within the black epoxy of these modules.

The ROM BIOS, which bears a Phoenix copyright, is also located on the main logic board. According to Tandy, this BIOS is designed to mimic that of IBM's PS/2 Model 80 rather than the Model 70 the 5000 MC more closely resembles physically.

The shape of the board itself is that of a chevron with one arm somewhat atrophied. The board skirts around the edges of the drive bay and under the power supply to fit the maximum possible board space in the confines of the chassis. Indeed, the use of separate logic and memory boards was compelled by a lack of main board real estate rather than upgrade flexibility, according to Tandy. Although circuit components on the board are somewhat generously spaced (at least when compared with those on an IBM PS/2 planar board), the 5000 MC relies heavily on VLSI circuits (chiefly the Intel Micro Channel implementation) and space-saving surface-mount devices. The design, layout, and construction are all well finished, although a few green jumper wires (so-called "engineering change orders")

marred the main logic board of the production-model evaluation machine.

Connectors for eight expansion slots are arranged at the left rear of the system support board using the same spacing as an AT, 0.8 inch, a factor that likely made the adaptation of an existing case relatively easy. Similarly, the slots have AT-class headroom, more than an inch in excess of what Micro Channel boards require.

Of the eight expansion slots, three are reserved for special system functions (plugging in the CPU board and memory boards) and use proprietary connectors, leaving five Micro Channel slots for expansion. Two of these are equipped with 32-bit connectors and electrical characteristics of slots in IBM's PS/2 Models 70 and 80 (that is, DMA can address only the first 16MB of the address range of the 80386 microprocessor). Two slots are of the unadorned 16-bit Micro Channel variety found in the PS/2 Models 50 and 60. The remaining slot uses the 16-bit MCA bus with the special IBM video extension for adding in graphics coprocessor boards such as IBM's 8514/A.

In the evaluation machine, one 16-bit Micro Channel slot was filled with an Adaptec ACB-2610 hard disk controller that accompanied the optional hard disk. According to Tandy, the ACB-2610 was the highest-performance ST-506 adapter they could find that was compatible with the Micro Channel bus. Other 5000 MC drive options use other controllers or host adapters, depending on the interface used. Both ESDI-based and SCSI-based hard disk subsystems are available as options for the 5000 MC.

MASS STORAGE MASTERY The 5000 MC also varies from both AT and PS/2 practice when it comes to mass storage options. The larger chassis of the 5000 MC (when compared with IBM's desktop PS/2 series) buys mass storage space in addition to extra slots—a total of four disk drive bays.

One bay, near the upper-right corner of the chassis, holds a half-height 3½-inch device and is filled as standard equipment with a 1.44MB floppy disk drive, a Sony MFD-17W-70D in the evaluation machine. Immediately left of this bay is a second 3½-inch bay that will accommodate a

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full-height hard disk or other device.

The drive in this left-hand bay is se-
cured to a removable metal mounting tray
that attaches to the front panel of the chas-
sis by two screws. The drive is attached to
the tray conventionally, by three screws in
its side mounting holes. A fourth screw is
not used because it would conflict with the
mounting hardware of the righthand flop-
py disk bay.

The standard-equipment floppy installs
with three screws in its conventional
mounting holes holding it inside its bay.
Again, the fourth screw is not used in order
to avoid conflicts with the adjacent bay.
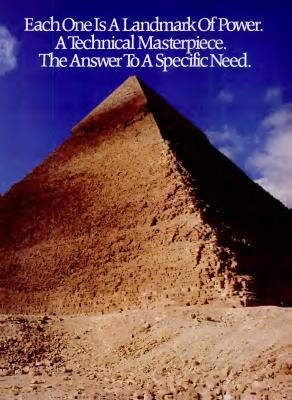
The only downside to this mounting ar-
rangement for 3½-inch devices is that the
right floppy disk must be installed first (or
the hard disk must be removed before re-
moving the floppy). Because the floppy
disk is standard equipment, this arrange-
ment does not present a major design
shortcoming.

Directly below the side-by-side 3½-
inch bays are a pair of over-and-under 5¼-
inch drive bays that can be used for a single
full-height drive or two half-height de-
vices. Both bays have front-panel access.
AT-style adapters allow these bays to be
used for 3½-inch drives, should you re-
quire it.

Both of these 5¼-inch bays use propri-
etary nylon mounting rails, which come
installed in the 5000 MC system. These
rails are an intelligent improvement over the
ordinary AT design. Once the rails are
mounted on a drive, they slide and latch in
place in the system chassis, without tools.
An inch-wide copper panel on each rail
grounds the drive to the chassis, eliminat-
ing the need for separate ground wires.

The Tandy power supply offers three
disk drive power connectors, a sufficient
number for normal expansion of the 5000
MC, because the standard-equipment flop-
py doesn't use a connector. Instead, it re-
ceives its electrical supply through its data-
and-control cable. This cable is equipped
with two connectors in addition to the one
for the standard-equipment floppy: one for
a second 3½-inch floppy and another for a
5¼-inch floppy. The connectors are func-
tional duplicates, however, so only one ad-
ditional floppy drive can be connected to
the 5000 MC.

Bezels for 3½-inch floppy drives are

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molded into the plastic front panel of the 5000 MC case. When the second 3½-inch bay is unused or a hard disk is installed in it, its bezel area is covered by a blank panel that slips into the drive slot cutout. While this scheme eliminates the need for finding proprietary bezels when installing an aftermarket floppy disk, it also makes the use of internal 3½-inch tape backup units more difficult. Such tape drives will have to be installed in the larger drive bays and may require special extension cables for their input signals.

Unused 5¼-inch bays are conventionally covered over with removable blank panels. The top blank panel is attached by two screws. The bottom panel slides up and out once the blank above it is removed.

Several hard-disk options are available from Tandy, all at premium prices. The smallest are 40MB units, currently available using either the ST-506 or SCSI interface, each costing about $1,500. The evaluation system was equipped with an 84MB ST-506, a better buy on a bytes-per-buck basis at $2,000. The same capacity is also available with the SCSI interface for $399 more than the ST-506 product. Other SCSI capacity drives include 170MB and 344MB at $3,099 and $3,999 over base price. An ESDI drive with a 140MB capacity is available as an alternative at a cost of $2,399.

The drive in the evaluation machine was a Rigidyne (Control Data Corp.) Model 94355-100 with 100MB of unformatted storage. This drive formatted down to a capacity of 76MB and delivered an 18-millisecond average access time.

PIXELS AND KEYS Tandy supplies its own version of IBM's 101-key Advanced keyboard with the 5000 MC. In layout, the keyboard exactly duplicates IBM's product with 12 top-row function keys, a dedicated cursor keypad, and dual Ctrl and Alt keys flanking the Spacebar. The only visual difference between the two is that the Tandy product puts the green LED indicators for locking Shift keys in the keys themselves, while IBM rounds up the three lights and corrals them at the upper-right corner of the keyboard.

Besides the layout, Tandy tried to duplicate the IBM keyboard feel and has

come reasonably close. The Tandy keyboard gives genuine tactile feedback with a very light mechanical keyclick. Its touch—the pressure needed to activate individual keys—is somewhat lighter than the IBM's, a feature that many typists may prefer.

The tops of the keys on the Tandy keyboard have a more-pronounced concave curvature and lack the raised plastic bumps on the home-row F and J keys and the central numeric 5 found on IBM's keyboards. This difference is trifling, particularly when allowing for the vast superiority of the Tandy keyboard when compared with those of many other makers, most notably Compaq.

The coiled cable, which extends from about 4 to 9 feet, is permanently connected to the keyboard. To match the 5000 MC system unit, it uses the same 6-pin miniature DIN connector as does IBM. In fact, the IBM and Tandy keyboards proved interchangeable, each working with the other manufacturer's computer.

Although no display is included in the base price of the 5000 MC, the likely choice is the monitor that accompanied the evaluation system, a Tandy Video Graphics Monitor model VGM-300. This 14-inch fixed-frequency color VGA-compatible display uses analog inputs and the same 15-pin high-density D-shell connector as official IBM displays. Neither its 74-inch video cable nor its 66-inch power cable is detachable.

The 14-inch screen produces an active viewing area that measures about 12 inches diagonally. The image is moderately bright and has good color saturation and sharpness throughout its control range. Brightness and contrast controls are presented as thumbwheels tucked under the left corner of the screen bezel. A rectangular power button and a green LED power indicator are part of the bezel itself.

Rear-panel controls include only three vertical-size controls to allow individual adjustment of image height in any of the standard VGA operating modes: 350 line (EGA compatible), 400 line (text and double-scanned CGA), and 480 line (VGA graphics). The case is reasonably compact, at 12 by 14½ by 15 inches (HWD), designed to sit flat atop the 5000 MC without a tilt-swivel base.

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PERFORMANCE MATCH Implementation of IBM's Programmable Option Select is part of the Micro Channel standard, and the Tandy 5000 MC correctly follows through. As with IBM PS/2s, the 5000 MC is set up using a software procedure contained on a special Reference Diskette accompanying the system. Following with IBM practice, the Reference Diskette also includes system diagnostics. But unlike most PS/2s, the 5000 MC also has two banks of eight DIP switches and several jumper blocks for configuring the system.

One jumper block is the easiest to understand. It resets the system's CMOS configuration memory back to its factory defaults. The procedure is necessary because the internal battery power in the CMOS memory module cannot be disconnected should the system accidentally get into an illegal or irrecoverable setting.

The DIP switches and the rest of the jumpers configure the 5000 MC to use different sizes and quantities of memory modules. Considering that the 5000 MC allows only four different memory configurations, the number of switches and adjustments seems excessive. Ordinarily, however, you won't have to deal with them.

Entirely menu driven, the Tandy software setup procedure sets system options, handles low-level disk formatting, and controls features such as three levels of password protection (boot-up, keyboard, and network access) and fast or normal keyboard speed. The Tandy setup system works like the IBM prototype, using Adapter Description Files and allowing expansion products from third-party vendors to seamlessly blend into the system setup procedure.

On today's personal computer market, the Tandy 5000 MC ranks as a high-performance machine, although its 20-MHz clock speed prevents it from rivaling today's top performers running at 25 MHz. At its speed level, however, the 5000 MC performs extremely well. It handles the 80386 Instruction Set test somewhat faster than big-name competitors like IBM's 20-MHz PS/2 Model 70 and Compaq's original 20-MHz Deskpro, and scores just behind Dell's Model 310.

The memory-access speeds of the 5000 MC are as fast as or faster than those of its

competition. While the preproduction version of the 5000 MC examined in the First Looks section of *PC Magazine* had difficulty running PC Labs' extended-memory benchmark tests, the production model reviewed here raced through them. In fact, its extended-memory write times are remarkably fast, perhaps because of an interaction between the benchmark tests and the 5000 MC's memory cache.

The 5000 MC holds a potentially larger advantage over conventional-bus computers in its I/O performance, particularly in

> ■ The memory-access speeds of the 5000 MC are as fast as or faster than those of its competition.

multitasking and multiuser applications, because of its Micro Channel architecture. This speed potential will be tapped only when peripherals that take advantage of the Micro Channel's bus arbitration system become commercially available.

Of course, the use of the Micro Channel raises one important question: exactly how compatible is the 5000 MC's bus with that of IBM? The answer is that you probably won't have to give compatibility a second thought. The 5000 MC could deal with all the Micro Channel expansion boards with which it was tested.

As to software, compatibility also proved excellent. Moreover, because Tandy offers three operating systems for the 5000 MC—besides MS-DOS, a Tandy version of OS/2 and SCO Xenix are available—it can run nearly any single- or multiuser application on the market.

As with the extended memory handling, the VGA circuitry of the production 5000 MC has been improved from that of earlier prototypes. Where the earlier system fell short of complete register compatibility with IBM's own circuitry (losing points for rough diagonal scrolling and improper handling of timing), the production unit demonstrated smooth operation on all counts except one. Some direct register

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manipulations were not effective, such as a register-rotate-right instruction. The performance of the display system proved good, just slightly slower than that of IBM's own 20-MHz PS/2 Model 70. It lagged noticeably behind Compaq's 16-bit VGA but outran ordinary (non–Micro Channel) 8-bit systems.

NEW DIRECTIONS Perhaps more important than the 5000 MC itself are its implications about the direction the PC industry is taking. The cloning of the Micro Channel has a different complexion from that of PC- and AT-standard machines. To this day, most industry-standard-architecture computers are physically and electrically patterned after the IBM prototypes. For example, most AT clones duplicate the basic IBM design with two stacks of 5¼-inch form-factor drive bays, one bay reserved for internal hard disks, eight slots arrayed on the left side of the computer, power supply tucked in the rear. Even system boards are of similar dimensions and laid out like IBM's. The cases are dimensional duplicates, and even the styling strongly resembles the work of IBM.

The 5000 MC and other machines soon to be on the market show that Micro Channel compatibles will not fit this pattern. Each one has its own look, capacities, and abilities. Upcoming Micro Channel machines from other vendors also demonstrate new design independence.

Advanced Logic Research, perhaps better known by its initials, should now be shipping its first Micro Channel machine, the MicroFlex 7000, that provides more mass-storage options and higher-quality video than either Tandy's or IBM's offerings. An 80386-based computer running at 25 MHz, the MicroFlex 7000 is designed as a top-performance PC with a 128K static-RAM cache (based on 25-nanosecond chips) and a unique 128-bit data path between the cache and main memory. Additional performance can be gained with its optional 80387 or Weitek 3167 numeric coprocessor. The vertically oriented chassis holds eight slots (five 16-bit, three 32-bit) and five drive bays (two full-height 5¼-inch, two half-height 5¼-inch, and a 3½-inch for the standard-equipment 1.44MB floppy drive). In addition to serial, parallel, and mouse ports, enhanced

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VGA circuitry is built in, offering resolution up to 800 by 600 pixels. The minimal configuration comes with 2MB of RAM (expandable to 16) and a 120MB ESDI drive for $9,499. The step-up model with a 300MB drive lists for $12,499.

American Mitac Corp. promises two Micro Channel compatibles in the next few months, both designed to beat IBM in the number of Micro Channel slots available in a desktop machine.

Due in late April or early May from Mitac is an 80386SX-based machine slated as a super-Model 50. This small-footprint machine will use Intel's 16-bit 80386 chip running at 16 MHz. Standard equipment will include built-in VGA circuitry, 1MB of RAM, a 1.44MB 3½-inch floppy disk drive, two serial ports, one parallel port, and six Micro Channel expansion slots. According to Mitac, it will be OS/2 compatible and will include a LIM EMS 4.0 driver and a target price of $2,700 to $3,000.

In late May, Mitac hopes to introduce a Model 70/80 compatible. A small-footprint machine like the Model 70, it will be electrically and logically more similar to IBM's Model 80, running its 80386 microprocessor at 20 or 25 MHz. Its standard features and ports will be the same as on the 386SX model, although some of its six slots will implement the full 32-bit Micro Channel. With 1MB of RAM and no hard disk, its estimated price will be about $3,500.

Wells American promises unique Micro Channel flexibility once availability of its PS/2 adapter module for its CompuStar system becomes a reality around April of this year. One of the $1,245 adapters will add five Micro Channel slots to an existing AT-bus 80386-based CompuStar, or two modules will stretch the machine to ten 32-bit Micro Channel slots. Models are available with 16-, 20-, or (starting February 1989) 25-MHz 80386 microprocessors coupled with a 32K cache of 25-nanosecond RAM chips and an Intel 82385 cache controller. Either an 80387 or a Weitek 3167 numeric coprocessor can be optionally added.

Standard features of the vertical-chassis CompuStar system include a wealth of drive bays: four 5¼-inch half-height bays with front-panel access, two 3½-inch bays

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with front-panel access, and one internal 5¼-inch full-height bay. Standard ports include two serial, one parallel, and one mouse port. Both EGA and VGA circuitry are built onto the system board, with the potential to increase resolution to 1,024 by 768 pixels (but no 8514/A compatibility) with a $195 upgrade kit.

With five AT-compatible slots, a 42MB ST-506 hard disk drive, a 1.2MB 5¼-inch floppy disk drive, and 1MB of RAM, the 16-MHz 80386-based CompuStar lists for $4,440. Up that to 20 MHz and pay $300 more. Operation at 25 MHz is $1,100 additional.

The design independence reflected by these computers and the 5000 MC is good both for the industry and consumers, because it promotes innovation. Freed from the constraints of the official IBM way of doing things, engineers can mix in the features and compatibilities that others neglected: slots, drive bays, higher-quality video, and cross-compatibility.
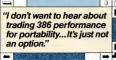
The downside to each manufacturer's design independence is the lack of the uniformity that has made most PC products interchangeable commodities. Without a single unifying design, you're less able to shop around for components. No longer can you buy a system board from one vendor and a case from another, put them together, and expect to have a computer equal to that of most minor manufacturers. You will face similar bottlenecks in waiting for proprietary replacement parts.

VANGUARD OR VICTIM? Will the Tandy 5000 MC and these other machines bring greater acceptance to Micro Channel architecture? Sales will be the final adjudicator. If users rush to buy Micro Channel compatibles as fast as factories can churn them out, no question will remain.

Still, the performance advantages of the new architecture remain a promise unfulfilled. Just as it was 2 years ago, the Micro Channel remains an architecture for the future. No current hardware product takes advantage of its potentials. However, the day when the Micro Channel will prove its mettle appears much closer. IBM has set the challenge; now the computer industry must rise to meet it.

Examined on its own, the 5000 MC is very good computer. It's fast, although not

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the fastest machine available. It's compatible, if you want to commit to the Micro Channel standard. It's compact. And it has good growth potential.

The 5000 MC is the closest IBM equivalent, the IBM PS/2 Model 70, the 5000 MC has little to be ashamed of. While the Model 70 can boast complete Micro Channel and IBM compatibility by definition, the 5000 MC gets as close as the industry has come to expect of clones.

The 5000 MC pulls ahead when it comes to expansion possibilities. Its roomier case, greater number of drive bays, and extra expansion slot make the 5000 MC a better choice in any application where demands on the computer are likely to grow (and that means nearly every application). The option of adding an internal 5¼-inch floppy disk will help offices in transition from PCs to Micro Channel standards.

As a first effort at Micro Channel compatibility, the Tandy 5000 MC is a surprisingly good computer. In fact, it's an excellent choice for a high-performance desktop PC, regardless of what bus is inside. Were all compatibles executed as well as the 5000 MC is, the Micro Channel might just become a quality as well as a performance standard.

Winn L. Rosch is a contributing editor of PC Magazine.

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SCANNERS BUILD A BETTER IMAGE

Image and text scanning for the PC has come a long way in 5 years. What started as a handful of specialized systems has grown into a mass market of more than 150 different products, ranging from $200 hand scanners to $16,000 optical character reader (OCR) scanner systems. A growing number of third-party developers are joining the fray as well, providing software for OCR, image editing, fax, and image databases.

This dramatic growth came from both the East and the West. The Japanese have improved scanning technology so that it can transmit information by the page—the only practical way to handle their iconographic language. And there's no doubt that the Japanese dominate the hardware market: Ricoh, Canon, Microtek, and other Japanese manufacturers produce over 95 percent of scanners sold in the United States.

America contributed the other market. Spurred on by the Apple Macintosh and by growing demands from the MS-DOS side, desktop publishing helped create today's image-hungry market. According to the market research firm Dataquest, scanner sales have increased an average of 250 percent annually from 1984 to 1987, with another 200 percent increase for 1988. The number of vendors seems to be quickly increasing, and the list of sophisticated features is growing. In just 3 years scanner manufacturers have doubled resolution, added gray-scale capability, and standardized file formats, creating a wealth of possibilities that are just now being explored.

FIERCE COMPETITION Desktop publishing also has made OCR more popular than ever. Fierce competition among the big players, in fact, has improved performance, driven down costs, and produced some real breakthroughs.

Four years ago, successfully scanning typeset documents would've cost over $40,000 and required a

Desktop publishing is only one application for today's text-and-image scanners. No one scanner-and-software combo offers everything, and these 21 desktop models are proving their mettle in diverse areas like image storage and retrieval, fax, and spreadsheet scanning.

minicomputer. Today, your PC can have similar capability for under $5,000. The new breed of OCR scans columns in one pass, adds formatting codes, paginates, spell-checks, and produces nearly finished files—all in the background. There is also a growing number of simple OCR software packages for under $1,000 for typewritten documents, line listings, and spreadsheets.

The biggest trend to watch in 1989 is the rise of third-party OCR and image-processing software. Jim Cavuoto, who publishes the *Micro Publishing Report*, has covered scanner and OCR developments for over 5 years. "We now have scanners that serve as a platform for independent applications software, where you can choose applications that you need," he notes. "There are image applications, OCR applications, and some PC fax boards with application software. Having independent applications is the key to the growth of the scanner market. As third-party developers come out and support scanning engines, you'll see an exponential growth in the types of things you can do with a scanner."

EVOLVING APPLICATIONS The predominant use for scanners remains desktop publishing. According to Dataquest, about 25 percent of the scanners sold have OCR capability, which suggests most buyers are concerned primarily with image capture. And while some scanners are also used in the CAD markets, these systems are usually too specialized for general office use.

One growth area for scanners may be facsimile transmission, or fax. Datacopy has offered a scanner-fax system for 2 years, and other vendors like The Complete PC offer scanner interfaces for fax. Yet the much-ballyhooed marriage between scanners and PC-based fax has not yet translated into big sales.

The other potential scanner market that holds promise comprises image storage/retrieval systems, which store documents as picture-pages instead of as a string of textual characters. Championed by products like AT&T's Overview Scanner, imaging documents lets you store not only the textual content of a page: any pictures, page format, even marginal notation can be stored in this fashion as well.

Image storage/retrieval represents the future for scanning on PCs. Enabling technologies like improved data compression, read-write optical disks, faster retrieval systems, and high-resolution displays are still a few years off.

HOW THEY WORK Most scanners bounce light off a page and measure how much light comes back. White reflects almost all the light, black absorbs most of it, and various shades of gray reflect light in proportion to their density. Most scanners

> Scanners take two approaches to continuous-tone images. The first is dithering. The other, relatively new to the PC, is gray scaling.

measure reflected light with a CCD (charge-coupled device), which sends different signals to the PC based on how much light is received. The various signals from the scanner are sent either to a coprocessor or to the PC's own CPU for processing. From there, what happens to the signals depends largely on the application software.

With image processing, there are several choices. With line or bitonal art, there can be only two values: black or white. Engineering drawings, pen-and-ink sketches, blueprints, and the like fall into this category, and the image processing is relatively straightforward.

Photographs and other kinds of continuous-tone images present another problem. A simple black-and-white photo of your backyard barbecue may have more than a million different values of gray. While these gray tones add depth to the image and make it appear realistic, the processing power required to get a million pixels right is well beyond the PC's capa-

bilities. Even if you could process it, there is no output engine capable of showing the full range of gray values; better output is often attained through a process known as dithering.

DITHERING ON THE JOB Scanner manufacturers have taken two approaches to handling continuous-tone images. The first is known as dithering. Gray values are measured, thresholded at specific values, then converted into a bitmap pattern based on those values. The darker the gray, the denser the pattern. Dithering remains the most common technique used for scanner output. It is usually stored in the .PCX format (Z-Soft's *PC Paintbrush*), although some scanners also use *Dr. Halo*'s .PIC format or the *GEM*–compatible .IMG format.

Like all bitmaps, dithered images can be edited using a paint program, but that's the extent of the manipulating capabilities. You can't scale images or manipulate image quality without altering every pixel. In many ways, a dithered image is the digital equivalent of an instant photograph.

GRAY-SCALING SCANNERS The other method is called gray scaling and is relatively new to the PC. Gray scaling is the digital equivalent of a photographic negative. Instead of converting gray values to a fixed pattern, the scanner software can store gray values with the file. The most common file format for gray scale images is called TIFF (tagged image file format).

The amount of gray-scale information depends largely on the scanner's capability, and on what you intend to do with it. Unlike the dithered image, gray-scale images are not given any specific pattern until they're printed out. You can store and manipulate a large number of gray values, but much of the information may be lost if you print them on a low-resolution device (see the sidebar "More Than a Black-and-White Decision").

Some of the scanner manufacturers aren't willing to hostage gray-scale output to third-party hardware—at least not completely. Microtek intends to announce a coprocessor board for the Hewlett-Packard LaserJet Series II that it claims will deliver magazine-quality gray scales. Intel has already announced a similar product, the Vi-

sual Edge System.

As output improves, the importance of gray-scale-manipulation software increases (see the sidebar "Brushing Up Your Gray Scales"). With image-manipulation software, gray-scale images offer desktop publishers the equivalent of a digital darkroom.

SCANNING AND OCR In the case of OCR, signals for gray levels are converted to either black or white, based on a threshold set by the application software. Most lower-priced OCR software uses a scanning method known as *matrix matching*, or font recognition. Character images are isolated, placed in a fixed matrix, and compared against tables of known images. When there's a match, an ASCII character is produced. Unrecognized characters can be flagged, or the OCR software can be instructed to make a "best guess." Some software can even be "taught" to recognize new or low-contrast characters either by your editing the original character table or adding an exceptions character table.

Matrix matching works best with monospaced characters, as found on type-writers, line printers, dot matrix printers, and letter-quality printers. Although some matrix matching claims to work with proportionally spaced characters, this usually means proportional output from IBM Selectrics and earlier-model daisy wheel printers. When shopping for lower-priced OCR software, expect it to be matrix matching.

FEATURE EXTRACTION Scanning books, newspapers, magazines, and other professional-quality documents, however, demands a more powerful recognition technology. *Feature extraction*, also known as feature recognition, is based on the principle that each letter has distinct features regardless of the font; the letter *R*, for example, has the same basic features whether it's printed in Times Roman, Garamond, Franklin Gothic, or Helvetica.

Feature extraction software examines the scanned image and then builds a list of features. When a set of features describes a specific character—in the case of an *R*, for example, an upright stroke with a bowl at the top and a tail running from the bottom on right—the software responds by

generating that character.

Feature extraction is independent of both the font and character spacing and so can be used on almost any kind of printed material. But decorative fonts, deliberate distortions, and other typographic touches may cause problems. Very tight letter-spacing and kerning (adjusting the space between letters) still pose the greatest stumbling blocks to feature extraction.

Some OCR manufacturers have gone well beyond character recognition to include document format information.

> Determine your production metrics: Who will use the scanner? How often, and for what existing or future applications?

scanners from the Kurzweil division of Xerox Imaging Systems and from Calera Recognition Systems (formerly Palantir) can scan multicolumn documents in one pass; double-sided documents can be scanned, turned over, scanned again, and then paginated. Tabular material can be scanned, recognized, and formatted for specific applications. And selective scanning can be used with databases, spreadsheets, and fax documents.

A SYSTEM FOR YOU The only downside to this wealth of image and OCR features is having to choose what you need. Even with falling prices, most desktop scanning systems start at $1,500, and you can spend 10 times that amount with little trouble.

Once you've narrowed down the amount you can spend, you have to consider how you'll use the scanner. Don't worry about resolution or gray scales until you've determined the production metrics: Who will use the scanner? How often, and

for what existing or future applications? What about the physical layout—desktop versus hand-held? Is the scanner for personal or public use? Who will manage and maintain it?

Carefully consider the type of scanner you buy. If you want one that's the digital equivalent of a photocopier, flatbed scanners have a definite advantage. They are preferred for accurate alignment of detailed line drawings, and you can copy pictures from books and magazines without destroying them. Best of all, flatbed scanners don't jam pages.

There are several new flatbed models that are similar to photo enlargers: the image is placed on a copyboard and scanned from above. The copyboard scanners are intended for scanning both pages and objects, but your success in 3-D will depend largely on the scanner's depth of field. In some cases, copyboard scanners require special lighting considerations; you may even need to put your unit in a special imaging room that will allow you to control lighting.

Roller-feed scanners with built-in page feeders are usually preferable for OCR and fax, particularly in an office with a limited need for image scanning. In this case, take pains to check over paper handling carefully. How easy is it to clear a paper jam, and can anyone do it? Also check to see how software handles jams, misreads, and other hardware errors.

You can get the best of both worlds by purchasing a flatbed scanner with a sheet feeder, but think hard about this "all-purpose" option. OCR and fax can take a lot of time, and that may frustrate artists who need quick scans on demand. Prices have fallen to the point where it's possible to cost-justify two scanners in a medium-size production center. A lower-priced scanner with sheet feeder can be attached to an AT as the text workstation, complete with OCR and in-board fax. The higher-priced imaging scanner can be tied directly to a production PC.

In a busy office where the scanner doubles as the fax system, your hardware should be particularly rugged. Look for easy-to-load trays and clearly labeled controls. Check the paper path: find out what it takes to clear a paper jam, and ask how much damage a staple will do. Examine

More than a Black-and-White Decision

When the time has come to take the plunge, you may be tempted to go out and buy the slickest scanner and the hottest laser with the fanciest features. After all, it's your publication. And it's got to look great, right? Before you buy that scanner, though, do a little homework and match the scanner, printer, and software to create the right look at the right price.

First, step back and take a look at what you want or need. A simple newsletter on a dot matrix printer requires a lot less horsepower than a book being sent to a type-setter. Scanning and printing a black-and-white cartoon takes much less sophistication than manipulating a multishaded landscape scene. When you know what you are going to scan and print and how it should look, you are ready to choose some equipment.

If you neglect matching your scanner's capabilities to your printer, you'll just be wasting features. An Epson FX or LQ printer can only print 144 or 180 dots per inch, and a Hewlett-Packard LaserJet prints at either 150 or, with extra memory, 300 dpi. An image scanned at 400 dpi will have to be enlarged to print properly (at 300 dpi), while a 200-dpi image will be scaled down to condense its dots into a smaller area. The scanner software may attempt to scale the image to the proper resolution, but an odd conversion of scanner and printer resolution can lead to misshapen renderings of the image.

Scanners can also detect a certain number of gray tones. Some devices, such as hand

Original black-and-white photo

scanners, try to convert the gray tones into a predefined and usually coarse dither pattern—often with poor results. When the image is scaled up, the original gray tones are gone and the dithered patterns are replicated. With more-sophisticated scanners, the gray tones are represented by a group of dots that more realistically recreate the gray in the image. It can then be scaled into a larger image with relatively little distortion of the original tones.

■ CONSIDER THE RESOURCE

Even if you're going for high resolution, you need to consider the resources required to store and manipulate the image. A single 8½- by 11-inch image scanned at 300 dpi eats up over 1MB of disk storage without gray scaling, and over 8MB using 256 levels of gray (four images, in other words, would fill a 32MB hard disk). Some packages require additional expanded memory to hold a large image. Although you would seldom scan a full page, a multipage manual with pictures and illustrations can quickly fill up a disk.

No one company has the ultimate combination of scanner, printer, and software, but there are plenty of products to choose from for the price you are willing to pay. If you're just loading images for a video database, a scanner like the AT&T Overview is all you need. If you do a lot of black-on-white scanning, you can get by with a simple, non-gray-scale desktop scanner or even a hand scanner like Logitech's ScanMan. A 300-dpi laser printer produces relatively poor output for high-level gray-scale work, so you'd only need a scanner with 64 or fewer levels to be effective. (The samples on the next page represent low-level gray scales.) Yet to produce magazine-quality output off-site on a 1,270- or 2,540-dpi device like the Linotronic L series, you'll want a scanner that can produce all the gray levels you can get.

The scanning software can also make or break your output. The package should take

300 dpi on a QMS PS-800+
laser printer

While no output engine today is capable of showing the full range of gray values present in a typical photograph, 16 levels of gray can take us as close as you need to be—depending on your applications.

The original photograph here was scanned using Xerox Imaging Systems' Kurzweil K-5000 at 450 dots per inch with 4-bit gray scales. The image's file size was 3MB. It was output first to a QMS PS-800+ (with Post-Script Version 46.1) at 150 and 300 dpi, then to a Linotronic high-end typesetter at 450 dpi—the image's original setting—and at 1,270 dpi. The 150-dpi sample, not shown, differed little from 300 dpi at the 16-gray-scale level. The same held true for the 450-dpi sample compared to 1,270 dpi; only the latter sample is shown.

can cut the time down to 30 seconds or less with the same resolution. The Varityper VT600 will print a 600-dpi page in a minute or two if you've got $18,000 to spend. Most people don't have the $30,000 to $100,000 to buy a Linotronic, but you can send your page or disk file to a professional typesetter and get 1,270 or 2,540 dpi for $10 to $40 a page, with 24-hour turnaround.

Discovering that you have chosen the wrong scanner is an expensive and frustrating lesson. Yet, with a little planning and the fruits of our research, you should have no difficulty identifying a scanner that will do the job for the right price.—Mike Falkner

1,270 dpi on a
Linotronic typesetting unit

advantage of the scanner's capability and render the image into a format that is easy to import. It should support popular formats like TIFF and .PCX and have plenty of tools to scale, clean up, and crop the image properly. Often desktop publishing packages like *PageMaker* also have tools to crop, stretch, and move an image once it's been imported.

■ **THREE-WAY TRADEOFFS**
To get the print quality you want, you'll need to make trade-offs involving resolution, cost, and often time. Depending on the complexity of the content, a $2,500 to $3,000 laser printer can produce a good 300-dpi page in a couple of minutes (unless you're handling images with gray scaling, the slowest of which took us 3½ hours to print). By adding a $1,500 printer controller like the LaserMaster, you

BRUSHING UP YOUR GRAY SCALES

Gray-scale scanners capture more than just a pattern of black and white. By measuring the intensity of reflected light, scanners can capture gray scales, or tones of gray, which give images the appearance of depth. If you've ever copied a photograph on a photocopier, you've seen what happens when you lose gray information. Highlights become distorted blobs of black with scatterings of gray, or bright whites with no values.

Earlier scanners avoided the problem by measuring values of gray and assigning them a specific pattern (dither) based on a square of pixels, which became the halftone dot. On some systems you can select the type of dithering pattern, but whichever you use, in most cases you're limited by the output resolution of laser printers. A 4-bit pattern produces 16 levels of gray with a halftone screen of 70 lines—worse than the daily newspaper and with far less detail.

While today's gray-scale scanners can often capture 64 or more shades of gray, the need often arises for retouching, altering, or completely changing an image before converting it into a halftone screen for printing. Until recently this meant turning to Z-Soft's *PC Paintbrush Plus* and proprietary editors as the only means of manipulating images. Control was minimal. And although some of these packages allowed global contrast, brightness, and tonal changes, most of

the information was lost during conversions to bitmaps.

A new crop of gray-scale image-editing software, however, promises to broaden horizons on the PC. Some packages, like Hammerlab's *ScanDo*, are sold along with scanners. Z-Soft is rumored to be offering a new gray-scale version of *PC Paintbrush* that will allow more than conversion to dithered bitmaps.

Aldus Corp. offers *Snapshot*, a videocapture system with a gray-scale editor. *Snapshot* offers global or selected contrast, brightness, and gain, changing values of gray, posterizing, and sprayed patterns. It stores halftone screen settings in either TIFF or .EPS format (up to 256 levels of gray).

Microtek will soon introduce one of the most ambitious and powerful gray-scale editors for the PC: *Picture Publisher*, which boasts an impressive array of features. Like *Snapshot*, *Picture Publisher* can retouch images, smooth lines, spray gray patterns, and manipulate global controls like brightness and contrast. But *Picture Publisher* goes further, introducing users to masking techniques and customized output that adapts images to output engines. *Picture Publisher* can also save settings as defaults for future image processing.

I had a chance to try a beta version of *Picture Publisher* and found it nearly addictive. Once you have an opportunity to

change tones, touch up areas, and use smoothing techniques, you realize just what is possible on the PC. Microtek documents the obvious limitations using VGA (the lowest acceptable resolution for editing) and describes in detail the technical considerations for final output. Even with VGA's limitations, I found more things I could change on the test images than I had time to take on.

Picture Publisher runs under *Microsoft Windows*, so for many desktop publishers it will fit in nicely with a suite of *Windows*-based applications (Aldus's *PageMaker* and *Micrografx Designer*, for example). Microtek also uses an image-caching technique, so you don't have to invest in EMS memory.

If you're serious about manipulating gray-scale images, you should have at least a basic understanding of the principles of photography, along with a strong working knowledge of how commercial printers use halftone screens to prepare art for printing. You also must understand how gray-scale information is displayed and printed on the PC.

Once you're familiar with how to make use of gray-scale information on a PC, you're ready to spend time learning how to retouch images electronically. Spending time with software like *Picture Publisher*, or other gray scale editors, will give you the experience you need to master the endless array of possibilities for images.—Tom Stanton

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the construction, particularly of the paper trays, and make sure that the hardware will be able to take some abuse.

Once you've settled the physical layout and operation, you have most of the information you need for evaluating application software. Systems that'll be used by a number of people need software that's relatively easy to use. Automated OCR and fax should be a primary concern here, and if imaging is low on your priority list, a dithered pattern may be all the imaging manipulation you need.

Choosing gray-scaling software and

other image-manipulation utilities will depend largely on the kind of publishing you're doing. Check your publishing software to see what kinds of graphics file formats it accepts, and then see how much memory you'll need to handle them. *Ventura Publisher 2.0*, for example, can display gray-scale TIFF files, but you may need to hve 2MB of expanded memory available to use this feature. See whether the publishing software allows you to manipulate the image before printing and, again, determine your system requirements before you make a decision.

THE REVIEWS To help in making a more-informed decision, *PC Magazine* reviews 21 scanners representing both the image scanning and OCR markets. Included are products from AVR, AT&T, Canon, Chinon, CompuScan, DEST, Hewlett-Packard, Microtek, Mitsubishi, Panasonic, Pentax, Ricoh, Saba, Shape, and Xerox Imaging Systems' Datacopy and Kurzweil divisions.

But still there were some notable no-shows. Because this review focuses on black-and-white desktop units, for instance, no color products from Howtek or

Suitability to Task

No scanner or OCR can mean all things to all applications, especially when the manufacturers have targeted such diverse markets as desktop publishing, image storage and retrieval, and fax linking, among others. Regardless of this diversity, products intended for output must measure up to the standards the industry has fostered throughout the evolution of scanner technology.

To help you choose the right scanner for your own applications, PC Magazine's suitability-to-task ratings provide an informed (though subjective) measurement of how well each model implements the basic features users would expect to find, given the way the vendor has positioned the product. Ratings take into account the intended market and this unit price—plus the cost of the software required to make the shine.

Each scanner is rated on four tasks, two for OCR and two for graphics capabilities.

OCR: Mono and proportional-spaced fonts. The product should accurately scan a wide variety of fonts within the 8- to 14-point range, without taking an unreasonable amount of time even when attempting monospace variations of the 10-point Courier sample: underlines, boldface, italic.

Graphics: Line art and halftones. The scanner should not take an inordinate amount of time to scan either line or halftone art at its highest-quality setting. Nor should the resultant files take an excessive amount of hard disk space or RAM. For line art, the unit should deliver a clean, unsmudged image, free from misshaping of geometric figures. Grayscale or dithered scanning should yield a crisp, clear output image that demonstrates high resolution.

0—no such capabilities offered

poorly suited to output

somewhat capable

SUITABILITY TO TASK

Product Name

OCR: Monospace fonts:

OCR: Proportional-spaced fonts:

Graphics: Line art:

Graphics: Halftones:

| | 1 | 2 | 3 | 4 |

well suited

close to perfection

The ratings, on a scale of 0 to 4, are presented in separate boxes that accompany each review. They translate as follows: 0—no such capabilities offered (though they may be available using software from third-party vendors); 1—poorly suited overall; 2—somewhat capable, but hampered by one or more factors; 3—well suited; 4—close to perfection in this respect.

Remember that these ratings have been adjusted to reflect pricing and market positioning. Thus, a score of "2" might imply that one scanner's performance is capable, but not sufficiently outstanding to justify its high price. In another case, a "2" might indicate that a scanner has an unexpected (albeit very limited) ability to handle some task that is not emphasized in the product's advertising. In every instance, of course, a "4" would indicate an excellent bet.

Sharp are represented. Abaton, IBM, Totec, and The Complete PC were unable to make our deadline for receiving products. Compugraphic, Kyocera, and Intelligent Optics were still putting finishing touches on new scanners at presstime. E.I.T. and Princeton Graphics' existing scanners have been reviewed before (see "Scanners

Take Off," PC Magazine, October 13, 1987). And while the CDP 9000 from Canon is not reviewed among the others here, its add-on board/software combination, True Scan, has been included in a separate sidebar (see "Supercharging Your Scanner").

What remains is a wealth of possibility.

The big names in scanner engines—Canon and Ricoh—are now competing with Hewlett-Packard, Mitsubishi, and Panasonic. The "Gang of Four" that pioneered the American market—Datacopy, DEST, Kurzweil, and Microtek—are here in force. So are newer players like Chinon, Pentax, and Saba Technologies, the latter of which is already a presence in the hand scanner market.

Besides showing you what features each scanner offers, these reviews show you how the players in the scanner game have changed to meet the market. There are now some big players, and the shakeout of startups has settled down. The result is a more robust product offering than ever before, with the right mix of hardware and software features to fit almost any imaging or OCR application for PCs today.

The maturing market scanner reduces the consumer's risk. It adds stability to the emerging third-party applications. As software catches up with the hardware's potential, PC users will realize just how far they've come, and the almost unlimited potential for the future.—Tom Stanton

Advanced Vision Research Systems Inc.

Though not widely acknowledged, most vendors' scanners use common engines made by third-party manufacturers. Placed inside varying chassis models and branded with different vendor names, the engines assume new identities but operate basically the same.

Not so with Advanced Vision Research Systems (AVR) of San Jose, California. AVR is an original manufacturer providing proprietary scanning technology to satisfy a range of needs. Its core products, the AVR-302 flatbed scanner, MegaScan software, and the MegaBuffer Card, can be purchased together for $2,695. These products are also sold separately, since individually they offer compatibility and enhancements to other manufacturers' scanning, printing, and desktop publishing products.

THE AVR-302'S TEAM MegaScan software, sold separately for $650, is an image-scanning program based in the GEM

environment, a relationship that makes it an ideal companion to any other GEM-based product, like *Ventura Publisher*. As a standalone product, *MegaScan* provides an assortment of graphic editing tools to enhance scanned photos and art, along with several formats for preserving these images. Included are TIFF, PCX, .IMG, and two CCITT Group III fax file formats. The software offers four predetermined contrast controls and standard input resolution of 300 dots per inch.

MegaScan can also be used to combine scanner-originated text and graphic files, or any other files in supported formats. In this respect, *MegaScan* acts as a page-layout program. This capability, along with a self-contained word-processing program for additional ease and flexibility, is so

SUITABILITY TO TASK

AVR-302

	1	2	3	4
OCR: Nonspaced fonts				
OCR: Proportional-spaced fonts				
Graphics: Line art				
Graphics: Halftones				

phisticated enough to have produced the entire documentation provided with the program. *MegaScan* could be enough to satisfy many users.

The MegaBuffer Card, a multiuse memory board, retails on its own for $1,095 and comes with 1.3MB of onboard memory to enhance the speed of image scanning and processing. While the board can be used with the AVR-302 scanner, it also supports the Canon Image Scanner IX-12F and the Hewlett-Packard ScanJet.

What's unique about the MegaBuffer Card is that it can also be used with *MegaScan* as a laser printer controller as well as with other products. It allows full-page 300-dpi printing, regardless of the amount of memory the printer has installed—possible because the MegaBuffer Card processes the page image before it is dumped

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to the printer. The MegaBuffer laser printer interface is considered just another output device to an application, and AVR provides device drivers for supported applications.

"PRETRAINED" SOFTWARE AVR also sells *MegaRead*, a $650 OCR program that reads both mono- and proportional-spaced fonts. The software is pretrained to read Courier, Letter Gothic, Prestige Elite, and Omni. The acceptable size range for typewritten, or monospaced fonts, is from 8 to 14 points. Typeset or

proportional-spaced fonts can be read in a wider range—from 6 to 20 points. AVR claims *MegaRead* can be trained to read any typeface, even those "as deadly as dot matrix or as archaic as Old English.'"

In general, *MegaRead* fared respectably in all our font tests—including several proportional styles that it was not pretrained to read. In one font tested for which it was pretrained, 10-point Courier, *MegaRead*'s performance rated among the highest of all scanners tested. It did experience trouble, however, in interpreting certain punctuation such as quotation marks,

The AVR-302, flatbed scanner, MegaScan software, and MegaBuffer Card sell for $2,695, but are also sold separately, as they offer compatibility with other manufacturers' products. The MegaBuffer Card comes with 1.3MB of on-board memory to enhance image scanning speed.

apostrophes, and exclamation points.

The MegaBuffer did appear to enhance the speed of graphics scanning and processing. Only 6 seconds was required to bring in a 4- x 5-inch photograph scanned at 300 dpi, and 17 seconds to save it in the TIFF file format. If speed happens to be your main priority, as when you're scanning images for use only in electronic formats (like image databases), this scanning package offers a clear benefit.

But if professional-quality output is essential, bear in mind that the AVR-302 is incapable of true gray-scale scanning. Instead, 32 levels of dithering are used to simulate gray scale. Additionally, the aspect ratios of image and line art produced through *MegaScan* in our tests were curiously distorted. The manufacturer had no idea what caused this occurrence and suggested it may be linked to the manner in which the files were interpreted by the particular application used to print our test images. In any case, it would have been possible to adjust the images to reflect the proper aspect ratios.

When you purchase all of them, the AVR-302 scanner, its accompanying memory card, and the text- and image-scanning software are not inexpensive. But together they provide a well-rounded solution, with better-than-average OCR and sufficient image input—and all are compatible, easy to operate, and even integrable within the *MegaScan* page-layout module.—*Tami Peterson*

AT&T Audiographic Communication Systems

If you have ever thought that underneath the controller software, all scanners were pretty much the same, one look at the $2,300 AT&T Overview Scanner will quickly give you cause to change your mind. This piece of equipment puts a new angle on scanning, by letting you scan three-dimensional objects.

The Overview Scanner looks more like the Starship Enterprise than a conventional scanner. Its head is mounted on an arm that overhangs the scanner bed, and two fluorescent tube lights protrude on either side. You place documents or objects you wish to scan faceup on the bed. Anything up to 1½ inch high (and in some cases an inch or so higher) that will fit within the 8- by 10-inch scanning area is fair game for this machine.

AT&T Overview Scanner

OCR:
Monospaced
fonts

OCR:
Proportional-
spaced fonts

Graphics:
Line art

Graphics:
Halftones

This 3-D capability isn't the only departure the Overview Scanner makes from its brethren: it is also designed to put high-quality images on-screen quickly rather than produce high-resolution hard copy. The scanner's maximum resolution of 80 dots per inch makes it poorly suited to desktop publishing applications; printouts of its scanned-in images lack the clarity and detail achieved by its competitors. But this product is not intended for output. AT&T instead is targeting communications functions like teleconferencing and image databases.

THE OVERVIEW'S SOFTWARE The $750 *Scanware* program that AT&T offers for its scanner includes capabilities that let

The unconventional AT&T Overview is capable of scanning 3-D objects up to 1½ inches high in its 8- by 10-inch scanning bed. Not intended for desktop publishing or other applications using output, the scanner ($2,300 without software) is instead recommended for teleconferencing and image databasing.

BRUTE OF
PRINTERS.

...tended.

This workaholic machine not only operates in true PostScript by Adobe,* it can emulate HP LaserJet Plus if need be. While its three ports mean you can link it with any RS-232C,

Multi-cassette paper feeder option adds up to paper versatility plus 750 pages.

AppleTalk or Centronics system.

What's more, it comes with a hefty 4 Mb memory. Which is plenty of room to handle any type of page, store dozens more fonts, and cope with complex programs.

Add all that to a rugged duty cycle of 25,000 pages per month, and you can see why the LZR 1260 was the only PostScript printer to earn *Publish!* magazine's five-star, "must buy" rating.
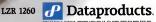
With optional 100-envelope feeder, it prints over 700 envelopes an hour.

And why *PC Magazine* concluded, "...this is the one printer to get when you'd otherwise have to get more than one."
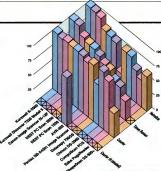
Performance Tests: Desktop OCR Scanners

The combination of a good scanner and good OCR software carries a hefty price tag. The absolute monarch of the OCR performance tests proved to be Xerox's Kurzweil K-5000, with a success rate of nearly 100 percent across the board in the OCR Scanning Accuracy test, and relatively fast scanning times as an extra bonus. The cost of this success, however, is nearly $16,000. (See also the sidebar "Supercharging Your Scanner.")

If your documents contain only the monospaced Courier font family, the Canon Image Scanner IX-12F, the DEST PC Scan 1020 and PC Scan 2020, and the CompuScan PCS all read this kind of text at a success rate of better than 98 percent. Move into the world of proportional spacing and you're back to Xerox, with both of its Kurzweil models (the K-5000 and the Discover 7320 Model 5) above the 98 percent success rate, which was not achieved by any others.

Confronted with gray shading (10 percent black), only the AVR-302 could read the text at all, achieving a hardly acceptable score of 83 percent. With any darker level of background shading, all of these scanners proved useless.

We cannot overemphasize that what really matters is the OCR Scanning Accuracy test scores rather than simple timings. Faster times may seem more appealing when you contemplate large OCR jobs, but you will pay significant labor penalties if you need to edit a document that is more than 10 percent incorrect. Also keep in mind that the scanners were tested only with the software supplied by the manufacturer (sometimes from a third party). No attempt was made to test other third-party software that might enhance a scanner's OCR ability.

Note that when the Scanning Accuracy score is 0, the related Scanning Time assumes a different significance. For instance, the ShapeScan SS-300+ spent 43 seconds on Times Roman, but this is not the timing for a completed scan. At the end of that time, the SS-300+ gave up and admitted that it did not know what font it was reading. While this was certainly a failure on the scanner's part, several other scanners took as long as 14 minutes to examine the shaded Courier 10 and arrive at the same conclusion.

OCR Scanning Accuracy

(Taller bars represent better performance)

Testing Procedures

Jody couldn't bear to look at the pony's eyes at his hands for a moment, and he asked very shyly, him. He put his hand out toward the pony. Its gre loudly, and then the lips drew back and the strong fingers. The pony shook its head up and down and s ment. Jody regarded his bruised fingers. "Well," I guess he can bite all right."

The 10-point Courier portion of the test document for the OCR Scanning Accuracy test.
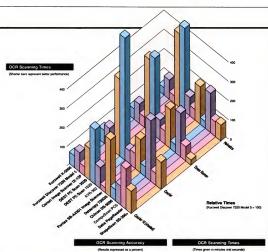
PC Labs used two tests to gauge the character recognition capabilities of the scanners reviewed. The OCR Scanning Accuracy test measures the percentage of the test document each machine could read correctly. The OCR Scanning Times test measures how long each scanner needed to scan the test document.

PC Labs tried the devices on a variety of common typefaces in four sizes, from 8 to 14 points. We are reporting the results only for Courier, Times Roman, and Helvetica fonts (the test document for each font contained all four sizes).

Gray-scale shading was also introduced in the 10-point Courier font, because testing the scanners on clean printouts was only part of the task. Not all documents are composed of clean, crisp type. Photocopies and newsprint, with their reduced contrast between background page and foreground type, are often much less legible (although in some cases a photocopier can actually be used to enhance the contrast before scanning).

To test worst-case scanning, PC Labs used PageMaker to create a document with five boxes containing progressive gray shading of 10 to 60 percent black. The 10-point Courier text was overlaid on each level of shading. We are reporting the results only for 10 percent black; the equivalent document would be an old, yellowed newspaper. At 20 percent black, an equivalent document might be text printed on a darker paper stock or highlighted with a marker; this level of shading proved impossible for these scanners to handle.

All fonts used in these tests were ITC variations as licensed by Adobe Systems for its PostScript implementation; they were produced on a QMS PS-800+ printer installed with PostScript Version 46.1. While these are commonly accepted typefaces, other variations exist, and slight differences in character style and kerning may significantly affect the success rate.

OCR Scanning Times
(Shorter bars represent better performance)

Relative Times
(Kurzweil Discover 7320 Model 5 = 100)

| | OCR Scanning Accuracy | | | | OCR Scanning Times | | | |
| | (Results expressed as a percent) | | | | (Times given in minutes and seconds) | | | |
	Courier 10 (shaded)	Courier	Times Roman	Helvetica	Courier 10 (shaded)	Courier	Times Roman	Helvetica
Kurzweil K-5000	0.0	100.0	99.4	99.8	3:05	1:45	1:25	1:17
Kurzweil Discover 7320 Model 5	0.0	97.5	96.5	98.7	5:01	2:35	2:37	3:22
Canon Image Scanner IX-12F	0.0	99.8	84.5	95.8	2:26	1:20	1:26	1:21
DEST PC Scan 2020	0.0	98.5	80.1	80.1	8:14	10:20	9:51	12:55
DEST PC Scan 1020	0.0	98.5	79.2	77.6	14:15	16:24	10:34	14:36
AVR-302	83.0	96.9	73.8	74.4	5:29	1:46	2:43	3.13
Pentax SB-A4301 Image Scanner	0.0	92.0	66.2	29.1	1:18	2:02	1:47	1:52
Datacopy 730GS	0.0	96.2	63.5	72.7	14:53	4:27	5:20	6:34
Chinon DS-3000	0.0	69.0	52.6	72.0	2:59	1:20	1:06	1:12
CompuScan PCS	0.0	98.3	49.3	54.7	5:02	8:05	5:54	6:54
Saba PageReader	0.0	88.7	32.3	46.1	10:35	1:35	1:57	2:34
ShapeScan SS-300+	0.0	41.3	0.0	59.1	5:50	3:38	0:43	2:45

■ DESKTOP SCANNERS

you transmit scanned images to other users
linked by modems. You can send them as
they are scanned or save them and trans-
mit them in sequence as a slide show.
Scanware also comes bundled with the
popular *PC Paintbrush* program so that
you can edit your scanned-in graphics.

Two third-party image database pro-
grams—Scanbase Graphics' *dBASE*-com-
patible *Scanbase* and DataEase Interna-
tional's *DataEase/Image-In* combina-
tion—are designed to make optimal use of
the Overview Scanner.

The Overview Scanner produces on-
screen images of exceptional quality in
VGA mode, thanks to its gray-scale capa-
bility. Rather than using dithering to simu-
late different shades of gray, it produces 16
true grays by controlling the intensity of
each pixel on the screen. (A remarkable 64
shades of gray will be available in a future
release of the software.) EGA allows only
four shades of gray, so at AT&T's recom-
mendation, we performed the perform-
ance tests with VGA.

The scanner proved a speedy performer
during our testing. And since the software
begins to draw the image on-screen while
you're still scanning, waiting time is kept
to a bare minimum. Setting the scanner to
a half-page further reduces scanning time.

One advantage of the Overview Scan-
ner's low resolution is that file sizes are rel-
atively small, making images easier to
store in a database or transmit over com-
munications lines. You can further reduce

The Overview produces on-screen images of exceptional quality, thanks to its gray-scale capabilities.

file sizes by using only four shades of gray
or just black and white, though this re-
duces image quality considerably.

TESTING THE OVERVIEW The
Overview Scanner created an impressive
on-screen reproduction of our test photo-
graph. It reproduced the grid test with no
noticeable distortion, although the edges
were cut off because of the 8- by 10-inch
size limitation on the scan window. The
Overview Scanner also did a respectable
job scanning in the various stopwatches,
add-in boards, magazines, and manuals
we presented it with.

One drawback of the system's top-lit
design is that glare from overhead lighting
can cause problems. We had to turn off
most of the ceiling lights to get optimal re-
sults on some of our tests, and the scanned
image of the gray-scale test page was
marred by a considerable amount of
streaking. This difficulty may have been
partly the result of glare on the test copy's
high-gloss finish, but even spraying the
copy with a matte finish failed to eliminate
the problem. (AT&T told us that a filter is
available to reduce glare but did not pro-
vide one in time for testing.)

Another difficulty arises with pages
that curl slightly at the edges. To avoid dis-
tortion in the scanned image, we had to de-
vise makeshift solutions using rulers or
Scotch tape to hold down the edges of the
paper.

But aside from these obstacles, the

Overview Scanner does what it was designed to do very well. It would be a good choice for scanning photos and signatures to add to a personnel database, scanning parts for an inventory database, or scanning drawings and models for use in teleconferencing.—Robert Kendall

Canon USA Inc.

The Canon Image Scanner IX-12F is a flatbed version of the Image Scanner IX-12, which was put through its paces for *PC Magazine*'s last scanner roundup (see "Scanners Take Off," October 13, 1987, issue). The $945 IX-12 accepts documents exclusively through a sheet feeder, while the $1,495 IX-12F lets you lay paper on a flat scanner bed or use an optional automatic document feeder. Otherwise, the two machines are identical. What is new is OCR Systems' upgrade of *Read-Right*—the OCR software Canon provides for the scanner. The resulting improvements in character recognition merited another look at the unit.

While a number of third-party graphics programs support the IX-12F as a graphics scanner (and scanners from companies like DEST and Hewlett-Packard use the Canon engine), we tested the unit solely with *ReadRight*, the OCR software included with the scanner. A straightforward pro-

The Canon Image Scanner IX-12F ($1,495 without software) lets you lay paper on a flat scanner bed or use an optional automatic document feeder. Its $595 ReadRight OCR software offers a straightforward user interface with impressive scanning rates on unshaded type.

gram, *ReadRight* doesn't require you to specify typefaces or typesizes beforehand. You just put the document in the scanner, hit Enter, and sit back. The program scans the page and performs OCR processing without the need for any further input, showing you the text on-screen as it is processed.

THE IX-12F AND FONTS You can configure the software for any of ten different languages. It also can handle a variety of monospaced or proportional-spaced fonts, even if they're mixed on one page. You can't teach the program new fonts, but then you may not find this necessary.

On the PC Labs performance tests, *ReadRight* performed well on all sizes of monospaced roman Courier, stumbling over only a few quotation marks. Errors became increasingly more frequent as it encountered the boldface and then the italic versions of this font.

Proportional-spaced fonts posed more of a problem. While it performed well on the Helvetica tests, with a medium-size serifed font like Times Roman, *ReadRight* made about as many errors as would a careless typist. The largest and smallest sizes of the same fonts, however, were much more mistake ridden. When it came to very large or very small proportional-spaced serifed fonts, the scanned-in version was so inaccurate that retyping it from scratch may have been easier than making corrections.

CROWDING THE SCANNER BED The Canon's flat scanning bed can handle paper no longer than 11 inches. If you want to scan legal-size documents, you'll have to add the $595 five-page automatic document feeder. *ReadRight* provides some additional input flexibility by letting you reduce the size of the scanning window and position it wherever you like. This feature lets you scan in a portion of a page only, a useful feature if you wish to ignore graphic elements that would confuse the OCR software.

SUITABILITY TO TASK					
Canon Image Scanner IX-12F					
OCR: Monospaced fonts					
OCR: Proportional-spaced fonts					
Graphics: Line art					
Graphics: Halftones					
	1	2	3	4	

You can save each page as a separate ASCII file or add each successively to the same file, retaining page breaks if you like. *ReadRight* also offers some flexibility in formatting text before saving it: the program can flush left all text, making it easier

Performance Tests: Desktop Graphics Scanners

Relative Performance
(Kurzweil K-5000 = 100)
(Shorter bars represent better performance)
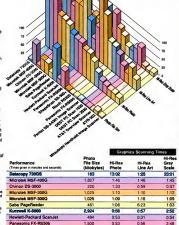
While it may be useful to compare the times and file size statistics presented here, be sure to check the output quality of any scanner you're ready to consider. In some cases, longer scan times result in larger files, as required by dithering or detailed gray-level information, and these larger files tend to produce better output images.

Neither speed nor size may be relevant to you, of course, if you need a particular quality of output; in that case, a mere $15,950 will buy you a Kurzweil K-5000. Although the Datacopy 730GS produced imperfect output, this may have been because the software used by PC Labs (Aldus Corp.'s *PageMaker*) could not handle either the 64- or 256-gray-level output from this scanner—a problem that will be remedied by the next generation of image-editing software. In any case, the Datacopy was slow; at 64 gray levels, its scan times were in excess of 23 minutes for the gray-scale page.

To measure **Graphics Scanning Times**, PC Labs tested how quickly scanners could scan in each of three graphics images at the highest available resolutions: a black-and-white halftone photo, a page of gray scales, and a piece of line art. These were taken manually, with the clock started at the inception of the scan and stopped when control returned to the tester. In cases where scanning was handled in the background, no other tasks were run in the foreground; completion times were recorded when the background process was finished.

The **Photo File Size** results indicate the size of the files containing the hi-res photo after each model had scanned it, before preparation for output.

Performance (Times given in minutes and seconds)	Photo File Size (kilobytes)	Graphics Scanning Times		
		Hi-Res Photo	Hi-Res Line Art	Hi-Res Gray Scale
Datacopy 730GS	163	13:02	1:25	23:01
Microtek MSF-400G	1,827	1:46	1:46	1:45
Chinon DS-3000	220	1:33	0:59	0:57
Microtek MSF-300G	1,025	1:10	1:10	1:12
Microtek MSF-300Q	1,025	1:09	1:10	1:09
Seba PageReader	461	1:06	6:23	1:03
Kurzweil K-5000	2,924	0:56	0:57	2:52
Hewlett-Packard ScanJet	484	0:53	0:31	0:54
Panasonic FX-RS506	1,500	0:53	0:56	2:48
ShapeScan SS-300+	120	0:46	1:57	1:48
Ricoh RS320	80	0:48	1:29	1:28
Panasonic FX-RS505	134	0:38	0:48	0:49
Pentax SB-A4301 Image Scanner	139	0:25	0:46	0:47
DEST PC Scan 1020	80	0:16	0:38	1:14
DEST PC Scan 2020	80	0:14	0:25	1:36
AT&T Overview Scanner	52	0:12	0:17	0:17
AVR-302	319	0:12	0:33	0:12
Mitsubishi Handheld Image Scanner	114	0:10	0:18	0:17

to reformat in a word processor, or it can preserve indentations, tabs, and flush-right alignment by adding spaces where necessary. It can add carriage returns at the end of each line or only at the ends of paragraphs. And it lets you save files directly in *WordPerfect* or *WordStar*, providing a utility for conversion to eight other word processor formats as well.

If you want an easy way to convert typewritten text to disk files, the IX-12E/*ReadRight* combination should prove a painless and reliable solution. It also scores high points for its flexibility in formatting text after it's converted. For most proportional-spaced documents, however, you'll need a higher degree of OCR sophistication than Canon can provide.—**Robert Kendall**

Chinon America Inc.

In the computer industry, price-to-performance ratios are never calculated in real numbers but rather in a subjectively perceived manner. With scanners, for instance, if your documents did not call for the inclusion of images, you'd probably never conceive of spending $2,000 or more to purchase a scanning device.

But if you could include images of original art or photographs and high quality was not an issue, you just might consider a total output of $800 to acquire a basic scanning device. Especially if it was easy to install and easy to use—and included a full-featured desktop publishing program, too. Look no further. Chinon America has put together a total desktop publishing package to suit users who perceive this very kind of price-versus-performance scenario.

INTRODUCING THE DS-3000 Chinon's new DS-3000 overhead scanner can be purchased for as low as $745 for the basic scanning device with image input software. For $50 more, the company will throw in a copy of Z-Soft's *PC Paintbrush Plus* and the exceptional low-end desktop publishing application *Publish It!* by Timeworks.

Images, or photographs, are what the DS-3000 appears to handle best. Though it offers no true gray-scale control, it does an admirable job of simulating gray scale with 16-level dithering when processing photograph-quality images or other art. Brightness is automatic, but contrast can

be controlled through the software or a manual dial on the unit. The line-art tests we performed proved to be less impressive than the results of the image tests. Scans at both 75 dots per inch and 300 dpi (the DS-

The Chinon DS-3000 is the answer for low-cost desktop publishing. For $745 you get the basic scanning device with image-input software. This portable scanner, intended to be used with multiple machines, is best suited for scanning images and photographs.

SUITABILITY TO TASK

Chinon DS-3000

	1	2	3	4	5
OCR: Monospaced fonts					
OCR: Proportional-spaced fonts					
Graphics: Line art					
Graphics: Halftones					

3000 resolution range) showed little discernible difference.

The DS-3000 incorporates a proprietary overhead scanning technology. Though the scanner's architecture is obviously designed in support of this technology, the long neck leading to the scanning head does provide a convenient handle to grab and lift the scanner with. Weighing

just 6 pounds, the DS-3000 is easily transported around the office.

The serial connection, which comes standard, makes it realistic for the DS-3000 to be used on multiple machines with little effort. When using the scanner with a serial interface, bits per second can be set to a maximum of 19,200.

Two additional connections are offered as well. A proprietary bidirectional parallel card and cable can be purchased for $145. (The company claims overall performance with this interface is superior to

Chinon's DS-3000 scanner does not require special lighting conditions.

that of the serial connection; we used the bidirectional connection in testing the DS-3000.) The other cabling option is a direct connection to a parallel printer, which bypasses the CPU entirely. This way, the DS-3000 acts as a photocopier.

TEXT SCANNING For a total of $995, Chinon offers a complete text-scanning package. Included are the DS-3000, the bidirectional parallel card and cable, Chinon utility (for image scanning), and an OCR program called *ReadRight*.

ReadRight uses a topological approach to scanning characters, but the results are closer to those found in typical pattern-matching OCR software. *ReadRight* isn't designed to read proportionally spaced fonts; consequently, it performed poorly in this part of our tests. It does have typeface-learning ability, though, so for this modest investment it may be worth your while to train the software to read your special fonts. But if your character-scanning needs are primarily limited to the monospaced fonts, this could be a suitable OCR package for you.

One of the benefits of using its overhead scanner that Chinon promotes is that no special lighting conditions are required.

(Lighting conditions are a consideration unique to overhead and hand-held scanners.) The DS-3000 adjusts to the room's light level when you power it up. However, since the overhead is generally between a room's light source and the material to be scanned, a shadow is cast.

Moving the scanner to various positions was necessary to produce the least amount of shadowing on a document. Even in doing so, nearly every scan was impaired to some extent with dimmed areas—especially damaging during the text scans.

Using the DS-3000 and its assorted software provides a low-cost solution to getting images into desktop-published documents. This could be important to those producing in-house newsletters, where photos of new personnel or those receiving promotions could easily be included. It's also good for company proposals and other promotional materials, where the personal touch of a photo might effect a sale.—*Tami Peterson*

CompuScan Inc.

Introduced 3 years ago, the $3,495 CompuScan PCS is primarily intended for document scanning. It has a multiple-sheet document source tray that feeds from the

rear and a paper-catching tray in front. The standard software, also called *CompuScan*, scans documents and saves the results directly in any of 15 different word-processing file formats or in a straight-ASCII text format. You can also set the hardware and the *CompuScan* software to recognize or ignore such formatting elements as underlining, superscripts, subscripts, variable tab spacing, and multiple fonts on one page.

The word processing formats you can choose from are *DisplayWrite 2, 3, or 4; MASS 11, Microsoft Word, MultiMate, OfficeWriter, Samna Word III, Volkswriter Deluxe, Volkswriter 3, WordMarc, WordPerfect, WordStar, WordStar 2000,*

Used primarily for document scanning, the $3,495 CompuScan PCS has a multiple-sheet document tray that feeds from behind and a paper-catching tray in front. You can save directly to different file formats and can set hardware and software to recognize or ignore specified formatting elements.

■ DESKTOP SCANNERS

and XyWrite III. In most cases the files are saved directly in the word processor's native format; with a few programs, an intermediate format is used. If you choose *WordPerfect*, for example, the files are saved in DCA (document content architecture) format, which is readable by *WordPerfect*'s CONVERT.EXE program.

> While the software did a reasonably good job with standard-type test samples, *CompuScan* had a difficult time with the smaller and larger fonts.

COMPUSCAN'S OCR METHOD

CompuScan uses a matrix-pattern-recognition scheme and only works with 10- or 12-point type. While the software did a reasonably good job with standard-type test samples (it loved the 10-point Courier), *CompuScan* had a difficult time with the smaller and larger fonts.

The program's difficulty in recognizing patterns led to very long page-reading times, with some samples taking over 10 minutes per page. If you use standard 10- or 12-point Courier originals, the time and performance might be better than our tests indicate.

If you want the PC to read fine art, the company sells *Dr. Halo* software under a private label name, CIES (CompuScan Image Editing Software), for single-bit graphics scanning. Because this program is identical to *Dr. Halo* in all but name, we didn't test this configuration or function. If you want to use the unit for graphics scanning, it costs an extra $500 for a proprietary parallel interface board and the graphics image scanning software.

BIGGER BUT NOT BETTER

The CompuScan PCS is a fairly large unit and looks awkward compared with some of the

newer units from Pentax or Panasonic. The PCS's feed-through mechanism limits the sources of original copy the scanner can handle, with a maximum sheet size of 8½ by 14 inches, a minimum of 5 by 3, and paper with minimum and maximum weights of 12 and 30 pounds, respectively; clearly the machine's design intention is for document originals. The feeding mechanism, however, tended to bend or wrinkle the leading edge of source documents and sometimes didn't keep the paper straight as it was fed through the unit.

The best news I can give you about the CompuScan PCS is that it can save directly to different file formats. If you need to handle various word-processing file formats, this machine might seem to be a good bet. But since virtually all word-processing programs will handle ASCII text, the PCS's ability to handle text-formatting codes really has to make a *big* difference in order to justify using it. The multiple fileformat capability has to work with a machine that I found to be a slow reader, awkward to use, and rather limited in the number of fonts that it reads.

It's a tribute to the scanner industry as a

SUPERCHARGING YOUR SCANNER

If optimum character recognition is your goal, your search doesn't have to end with the most sophisticated (and highest-priced) scanner/software matchup you can find. Replacement boards for existing scanners have lately begun to earn notoriety, and it's no surprise: a powerhouse product from Calera Recognition Systems (formerly Palantir Corp.) is working wonders upon scanners as relatively low-cost as the $1,095 Princeton Graphics LS-300.

Calera's TrueScan board-and-software combination goes beyond normal third-party OCR systems in that it isn't a scanner and it isn't only software. The product comes in two versions, differentiated by on-board RAM and maximum character recognition speed. The $2,495 TrueScan Model S has 2MB of RAM and at best can recognize 75 characters per second. The pricier $3,495 TrueScan Model E comes with 4MB of RAM and can recognize up to 100 characters per second. Both, the company claims, can read thousands of fonts with variations on each.

In place of your scanner's regular interface card, TrueScan runs your scanner, giving it both text- and image-reading capabilities. Scanned text input can be converted directly to any of 32 different word-processor formats, three

spreadsheet formats, three flavors of ASCII format, and eight image formats. The converted files include not just the text but also the document structure of the original. The TrueScan also works directly with PC fax boards, offering the ability to translate bitmapped characters into much more compact ASCII files.

ONLY END-USER PRODUCT Calera's scanner systems, like its flagship CDP 9000, are sold to OEM and VAR markets and to high-end dealers—often in complete turnkey systems costing up to $1 million. The current CDP line

ranges from $14,950 to $29,500. True Scan, however, is specifically intended for the personal computer market in ease of use as well as price.

The process starts when you scan in an image of an entire page into the board's memory. The system then assesses the page as a whole, making note of blocks of text and other elements. The next step is to recognize individual characters in a way that isn't strictly pattern matching or topological-formula based. If TrueScan isn't sure of a character by itself, it does some context and spell-checking, though it won't force a fit just to match a word in its lexicon.

Calera has trained the TrueScan in more than 1,300 business typefaces in roman, bold, and italic, each in sizes ranging from 6 to 28 points. From these variations the company claims the ability to read more than 16,000 fonts. While we didn't count, the samples we tried at PC Labs using an AT with an HP ScanJet and a TrueScan Model E had some problems because of very messy originals, but no perceptible difficulties with typefaces or size.

After a page is fully scanned—fully run through the product's recognition algorithms—the next step is to convert the file to your desired format. The computer's own processor and memory are used

PC FACT FILE

TrueScan
Calera Recognition Systems
2500 Augustine Dr.
Santa Clara, CA 95054
(408) 986-8006
List Price: TrueScan Model S, with 2MB RAM and maximum character recognition rate of 75 characters per second, $2,495; TrueScan Model E, with 4MB RAM and maximum character recognition rate of 100 cps, $3,495. HP ScanJet DX-12F Daughter Card, $295. Canon DX-12, DX-12F Daughter Card, $295.
CIRCLE 407 ON READER SERVICE CARD

whole that the CompuScan seems outdated; unfortunately, that doesn't say much for the CompuScan PCS itself. Compared with other units tested, the PCS looks large and old-fashioned. It's nice that it can save files directly in various word-processing file formats, but in our testing it was slow and not very flexible in recognizing different fonts. This is not a good buy.
—Bruce Brown

DEST Corp.

DEST built a well-earned reputation on the strengths of its popular OCR technology, offering reasonable-quality text scanning at a moderate price. But since the sudden

boom in desktop publishing has made graphics scanning even more fashionable, DEST's pair of midrange scanners, the flatbed PC Scan 1020 and the edge-feed PC Scan 2020, now offer respectable graphics in addition to average OCR capabilities.

The 2020's unique design makes it the better known of the two models. Its space-saving form lets it rest unobtrusively under a computer monitor, accepting and returning scanned pages through slots on its front. The only disadvantage to this design is that it accepts only single sheets. For scanning books and magazines, it's necessary to use the 1020's flatbed platen. Both scanners offer optional automatic document feeders for scanning stacks of pages.

If you're at all versed in scanners, the 1020 may look remarkably familiar, and for good reason. It uses the same Canon scanning engine as the popular Hewlett-Packard ScanJet. The DEST units differ from HP's ScanJet in software: both DEST scanners use *Publish Pac* and *Text Pac* scanning packages.

Publish Pac, a Microsoft Windows-based application, furnishes well-heeled text and graphics scanning. *Text Pac*, a memory-resident program that runs in the background, scans text directly into a word processor running in the foreground, formatting the text to the word processor's specifications as it goes.

to create a metafile that contains structural information about the document; this is used in the conversion process.

SETUP AND COMPATIBILITY The TrueScan software needs 4MB of hard drive space available for its files; you run it either from the DOS command line or from a menu. When you install the system, you tell it what text and image formats and what scanner and face board you have. If you need the extra slot, there are optional daughterboards that run on Canon and HP scanners.

Several major scanners can work with the TrueScan board, including models from Canon, Datacopy, DEST, Microtek, and Panasonic as well as the AST TurboScan, Princeton Graphics LS-300, and Hewlett-Packard ScanJet. TrueScan also works in conjunction with the Gamalink Gammafax, Panasonic's The Faxcard, Datacopy's Microfax, and AT&T's Fax Connection, converting received fax files directly to any of the supported application formats. Other scanners and fax boards are supported via TIFF and .PCX image files. (In order to work with the TrueScan system, faxes must be received in fine mode, 200 by 200 dots per inch.)

TrueScan blew through all our scanner test samples very quickly and read everything except text with gray background. We also gave it newsprint, *PC Magazine* articles, and a variety of other originals to test its performance. The fuzzy answer to the performance question is that the TrueScan did very well with these samples; its success rates across all unshaded samples outperformed even the $15,950 XIS Kurzweil K-5000. The TrueScan had more trouble with document quality than with fonts or formats. It didn't fare very well trying to read 5-point stock quotations on newsprint laid into *Lotus 1-2-3* format, but the point size was below the specified limit, and the thin paper allowed characters on the other side to show through.

There are less expensive alternatives for reading documents that are fine if your input is of consistently good quality. But if you have a wide variety of input sources and want to be able to work with fax-format files and fit the whole thing in with various text, spreadsheet, graphics, or desktop publishing programs, True-Scan currently has the lead. The product is not cheap, but if you need this kind of performance, you probably already know it and may have been frustrated by other, underperforming alternatives. The TrueScan system aren't perfect yet, but they're probably a lot better than anything else you've seen.—Bruce Brown

PC SCAN 1020 The PC Scan 1020 is the far more conventional of the two products. After a painless installation procedure, the unit provides line-art, halftone, and 4-bit gray-scale graphics scanning for a total of 16 possible gray tones. It scans text with equal aplomb, living up to the DEST standard.

With equal ease, the 1020 connects to either an IBM PC, an IBM PS/2, or a Macintosh. To enable such impressive flexibility, the system includes an adapter module that connects to either a PC or PS/2 interface card or directly to the SCSI port of a Macintosh. The adapter module also serves to hold the text processor card that comes included with the 1020 but that adds optional OCR capabilities to the less-expensive, graphics-only PC Scan 1000.

It's the software that differentiates this scanner, though, and for that DEST includes two varieties. *Publish Pac* is DEST's own *Microsoft Windows* application, recently upgraded for use with *Windows/286* and *Windows/386*. It delivers fine-point control over both text and graphics scanning, offering four different halftone patterns and precise control over the scanned area of a page. To make selecting the scan area simple, *Publish Pac* runs a low-resolution scan preview. Using the preview image, you simply position a Windows frame with a mouse to specify the scanning rectangle.

Publish Pac's lack of tools for any serious editing of scanned images is its only shortcoming. For that, you'll need to use the copy of *PC Paintbrush Plus* supplied to edit files saved in .PCX file format.

Publish Pac lets you scan text on a portion of a page, but the sole text file format it supports is ASCII. *Text Pac*, a 64K memory-resident module also included with the system, presents an alternative streamlined method of OCR scanning. *Text Pac* scans an entire page at a time,

PC Carnival.

Revel without a Claus.

In the festive town of Marlow, NH (pop. 557), the holiday spirit lasts long after Santa's packed it in for the year. In fact our sure-pawed mascots are already preparing for their annual Winter Carnival – a seasonal celebration featuring skating, sledding, sleigh rides and ice sculpture. This annual event certainly provides a welcome break from our usual winter sports, e.g. thawing frozen pipes, jump starting cars, putting out chimney fires, and skidding off the road into ten foot snow drifts.

Breaking the mold.
(Or, where's the P word?)
Our more loyal and linguistically-inclined customers may have noticed that we've abandoned the "P" words in our headlines in favor of the "C" words. Because after five years of parading a profusion of P patter past PC pros on periodical pages, we perceived that perhaps they paled next to the possibilities and potential

of creative constructions consisting of C words. 'Nough said. Rest assured, though, our letter-perfect mascots still stand (and occasionally sit, roll over, and do handstands) for everything true and noble in the microcomputer mail order marketplace. If you're looking for a single source for superior savings, sensational tech support, and specially speedy shipping, we're definitely your Connection.

The ice mammal cometh.
Wouldn't you like to wake up every morning to a vision of microcomputing's most magnificent mammal? Well, now you can do that *and* quench your thirst for a taste of Marlow's winter wonderland with your very own PC Connection mug. It features a crystal-clear likeness of our oh-so-cool, but heartwarming mascot, and is free to anyone who places an order of $500 or more between now and March 31st.

Just call 1-800/243-8088 or 1-603/446-3383, M-F 9:00 to 9:00; Saturday to 5:30. If you're planning to visit please call ahead.

Warm the cockles of your heart with a PC Connection
mug featuring the mascot who never skates on thin ice.
Offer not available to net accounts. One per customer.

For IBM Personal Computers exclusively.

PC CONNECTION®

SUITABILITY TO TASK

DEST PC Scan 1020

	1	2	3	4
OCR: Monospaced fonts				
OCR: Proportional-spaced fonts				
Graphics: Line art				
Graphics: Halftones				

DEST PC Scan 2020

	1	2	3	4
OCR: Monospaced fonts				
OCR: Proportional-spaced fonts				
Graphics: Line art				
Graphics: Halftones				

running in the background behind your favorite word processor. One keystroke combination starts a page scan, dumping formatted text straight into your current document.

The DEST text scanning capacity to automatically recognize typefaces and matrix-match them with its own pretrained fonts makes it easy to use. *Text Pac* and the text-scanning portion of *Publish Pac* recognize 12 different typewriter and daisy wheel printer typestyles, 5 laser printer typestyles, and the draft output of 5 popular dot matrix printers. When fed the Apple LaserWriter's Courier font, supported explicitly by *Text Pac*, the program interpreted our sample text in the best DEST tradition, with remarkable accuracy. But on the LaserWriter's Franklin Gothic and Times Roman, two typefaces similar to supported HP LaserJet cartridge fonts, *Text Pac* had more trouble. *Text Pac* also proved reluctant to switch to a new text size while reading a page. Our Courier text sample in four different font point sizes tripped it up.

When *Text Pac* encounters an odd typeface or a new text size, it struggles gamely and at length. *Text Pac* labored for more

than 14 minutes on our test page with Courier text over a shaded background. Its cryptic on-screen message "Hard to Read Page Entered" displays all the while but offers no inkling of whether it will succeed or fail. Since the result was often unusable, we would have liked to have known that a lot earlier.

These are minor grievances, though. DEST text scanning is the standard for moderately priced OCR.

PC SCAN 2020 Of the two scanners, DEST is justifiably more proud of its PC Scan 2020. Despite the 2020's inability to accept other than a single page at a time (an automatic document feeder is an option), it has some real advantages.

For those who already work in a crowded space, the 2020 slips between a monitor and PC system unit without taking any additional desk area. The 2020 doesn't even require the adapter module used by the 1020. In addition, its 8-bit gray-scale scanning recognizes 256 shades of gray. The 2020 correctly interpreted even the 10 percent gray scale on our test. That makes it a superb choice for scanning photographs for desktop publishing.

Keep in mind that 8-bit gray-scale files can be huge, though. The scan of our gray-scale sample page generated an 8MB file.

The 2020 uses the same interface card and *Publish Pac* and *Text Pac* software as the 1020, so those aspects of its use are

identical to the 1020's. DEST claims that the 2020 scans at more than twice the speed of the 1020, though. We found an increase of more than 20 percent in OCR scanning with the 2020, but neither scanner compared with the fastest OCR scan-

> For those who already work in a crowded space, the 2020 slips between a monitor and PC system unit without taking up any additional desk area.

ners in our survey. For line-art and dithered graphics scanning, the 2020 was somewhat faster than the 1020 at 300 dpi. For gray-scale scanning, it was slightly slower, but with much better results.

Speed is not the 2020's claim to fame, though. Its superior gray-scale scanning and space-saving design really make the PC Scan 2020 stand apart from the crowd. For desktop publishing, that makes it an excellent choice.—**Stephen Sagman**

Barely noticeable as it sits under a computer monitor, the $2,000 DEST PC Scan 2020 accepts and returns single scanned pages through slots on its front. Like the DEST PC Scan 1020, it offers an optional automatic document feeder for scanning stacks of pages.

Hewlett-Packard Co.

The $1,495 Hewlett-Packard ScanJet is a flatbed graphics scanner with gray-scale capability. Even with the optional document feeder, it maintains a low, flat design the size of a page plus a couple of inches all around and just a few inches tall. This design wastes a lot of desk space but is easy to work with.

As with the LaserJet printer line, this Hewlett-Packard product appears to share the engine and casing of its Canon counterpart, the IX-12F. The two use different interfaces and software, however.

Most software packages that directly control scanners support the Canon IX-12 (not the IX-12F), making it more or less an industry standard. The Hewlett-Packard ScanJet, however, has quickly picked up support from many packages and carries Hewlett-Packard's highly regarded name. With HP's usual aggressive marketing and pricing policies, it is certainly a major player in the market.

TESTING THE SCANJET The ScanJet handled all our tests without a glitch, scanning the pages from edge to edge. It returned circles after scanning circles, and offered four kinds of dithering or true gray-scale support for the photo and gray-scale

The solidly designed Hewlett-Packard ScanJet ($1,495 without software or cables) is a flatbed scanner with gray-scale capability; it works with all output devices supported by Microsoft Windows. A mouse is recommended for use with its scanning software, Scanning Gallery.

chart. The ScanJet is a 4-bit scanner, recognizing 16 levels of gray—the minimum for a scanner that claims to support gray scale. And while quality of the scanned gray-scale images is very good, it won't touch that of scanners with 64 gray levels.

Scanning Gallery, the software provided with the ScanJet, runs under *Microsoft Windows* (using a runtime version). It therefore will work with all output devices supported by *Windows,* including most major printers and plotters. It also supports many input devices, including mice and lightpens. While not required, a mouse is helpful and should be considered if the *Windows* software will be used frequently.

The limited graphics editing features are cut, paste, copy, and crop. If you want to do more with the images than that, you'll need a real graphics or desktop publishing package. It's no problem, though, even if the program that you want to use doesn't directly support the ScanJet.

Scanning Gallery exports files in *Microsoft Paint* (.MSP), *PC Paintbrush* (.PCX) and *GEM* (.IMG) formats as well as the usual TIFF format used by most scanners. It also supports a compressed TIFF format, which saves disk space but increases load time.

NO PARTIAL PAGE SCANS You can't specify a partial page scan area up front; instead, you have to scan the entire page in

Preview Scan, then define a smaller scan area by drawing a box around it. While this is not difficult to do, it is often a frustrating extra step. When the image you're scanning begins at the top-left-hand corner of the page or when you know its exact location on the page—and already know its di-

mensions—it would be easier to just type in a couple of numbers.

While documentation for scanners is not usually good or bad enough to deserve mention these days, Hewlett-Packard's is an exception. Well organized and thorough, it offers a tutorial on *Microsoft Windows,* instructions for loading a scanned image into Aldus's *PageMaker,* and plentiful pictures, helpful hints, and cross-ref-

Output Tests: Desktop Graphics Scanners

With graphics scanners, you can produce optimal output by using either the best dithering algorithm available or the maximum number of gray levels. The penalty you'll pay is in file size, with better output yielding the largest files (the Kurzweil K-5000 gray-scale image was 11MB). Given the 32MB limits of DOS 3.3 disk partitions, you might not be able to store more than two or three such high-end images at once.
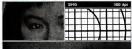
Original halftone

Original gray-scale image
(60 and 80 percent black not shown)

Original line art

Product name

	Price	Resolution

AVR-302

	$2,695	300 dpi

AT&T Overview Scanner

	$3,050	80 dpi

Chinon DS-3000

	$995	300 dpi

DEST PC Scan 1020

	$2,250	300 dpi

DEST PC Scan 2020

	$2,000	300 dpi

Hewlett-Packard ScanJet

	$1,990	300 dpi

Microtek MSF-300G

	$3,495	300 dpi

Microtek MSF-300Q

	$2,495	300 dpi

Three graphic images were selected to test the acuity of the current crop of desktop scanners: a 4- by 5-inch black-and-white photo with a full range of random gray tones; a page with two gray scales (having sections of 10, 20, 30, 40, 60, and 80 percent black) positioned along its outer edges and a solid black stripe running vertically between them; and a piece of line art consisting of four concentric circles superimposed on a full-page grid of 1-pica blocks.
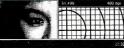
Although the images were scanned at both the highest and lowest resolutions available from the scanner software, only the highest-resolution results are presented here. The legend above each image indicates the price of the scanner (complete with software) and the resolution at which the images were scanned (the scanner's hi-res setting).

Microtek MSF-400G

$3,995   300 dpi

Mitsubishi Handheld Image Scanner

$995   200 dpi

Panasonic FX-RS505

$1,499   400 dpi

Panasonic FX-RS506

$1,899   400 dpi

Pentax SB-A4301 Image Scanner

$2,195   300 dpi

Ricoh RS320

$1,499   360 dpi

Saba PageReader

$1,295   200 dpi

ShapeScan SS-300+

$1,290   300 dpi

Datacopy 730GS

$2,690   300 dpi

Kurzweil K-5000

$15,950   400 dpi

erences. The optional $595 Automatic Document Feeder can automatically load roughly 20 sheets of paper, any size from 5½-inch square to legal. It works smoothly, and you should strongly consider it if most of your scanning work will be multiple-page documents.

The Hewlett-Packard ScanJet is available with interfaces for the XT/AT bus, the PS/2 Micro Channel bus, and the Macintosh. While the graphics software that Hewlett-Packard provides does little but cut, paste, and print, it does those things well. You can always use a third-party package if your needs are greater.

Scanning is limited to 16 gray levels, but these are 300-dpi sharp, and images are re-created faithfully. With its excellent quality, solid design, and great support, the Hewlett-Packard ScanJet is a top choice among flatbed graphics scanners.—Philip F. H. Rose

Microtek Lab Inc.

Welcome to the boutique. Microtek Lab specializes in PC-based scanning and sells an increasingly complete line of scanning devices and software. But rather than tout its newest and greatest products as the answer for all power users or aspirants, Microtek takes a refreshing applications-oriented approach to marketing its wares.

Both Microtek's literature and representatives focus on user output. If, for example, the highest-resolution device you'll be printing on is a standard 300-dot-per-inch laser printer, Microtek suggests you not worry too much about gray-scale levels or scanning resolutions beyond 300 dpi, and stick with one of the company's less-powerful machines. Normal laser printers can't take full advantage of gray-scale images anyway—in fact, they often produce better output from dithered single-bit images.

Microtek itself offers an answer to those who use 300-dpi lasers and need higher-quality output but are on relatively restricted budgets: a board-and-software combination, the GLZ, that for about $3,000 increases the potential gray-scale-output capabilities of 300-dpi laser printers to publication-quality levels. The board, combined with new gray-scaled editing software, takes you a giant step toward to-

tal desktop image independence.

Such lofty performance levels, however, are unnecessary and too costly for the more-typical users who need quality image scanning for something a step or two below magazine quality.

MICROTEK TRIPLETS The three units reviewed here, the Microtek MSF-300G, the MSF-400G, and the MSF-300Q, represent three levels of flatbed high-resolution gray-scale scanning. Other than price, the only differences among the units are resolution and number of gray levels. The two 300 units have a maximum resolution of 300 dpi while the 400 model offers 400 dpi. The Q model can read 64 levels of gray scaling, while the G's handle up to 256.

The capacities of the scanners, then, in ascending order of power (and price) are the 300-dpi, 64-gray-scale-level MSF-300Q for $2,495; the 300-dpi, 256-gray-scale-level MSF-300G for $3,495; and the priciest unit, the $3,995 MSF-400G, which scans up to 256 gray-scale levels and can read at resolutions of up to 400 dpi. Even the least-expensive of these machines is not a trivial purchase, so it makes sense not to overbuy. Just to complete the model designation translation, the letters MSF stand for Microtek Scanner Flatbed; their pull-through scanners are designated by MS alone.

NEARLY IDENTICAL The differences end there: beyond resolution and gray scale, these three units are identical, with the same cases, interface boards, cables, and software. This means little to you if you'll be buying only one scanner; however, if you need several units for a range of purposes and performance levels, it's a significant advantage that the board and cord, as well as the software, are interchangeable.

The MSF case takes up a fair amount of space, being approximately 2 feet deep and a little over 1 foot wide. At only 5½ inches high, they don't need much overhead space, but because they're flatbed models, you need enough clearance to raise the cover and to properly position your original on the scanner bed.

The half-length interface card fits in any 8- or 16-bit slot. Installing the hardware and software is no big deal, although the 13 program disks can be daunting. You cannot select interrupts and there's no polling, but you can elect whether to use a DMA channel to select the device's memory address. The scanner setup can be changed easily by software at any time, even while running either of the standard graphics-image scanning programs.

SOFTWARE MAKES IT HAPPEN Each of the reviewed units comes with the programs *EyeStar Plus* and *PC GrayScan*.

The $3,995 Microtek MSF-400G, Microtek's top of the line, gives you 400-dot-per-inch resolution and 256 shades of gray. All three Microtek models are excellent buys and, because they use the same boards and cables, are interchangeable.

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    - Math fonts
    - Legal fonts and much more
- Totally compatible with all models of the HP LaserJet Printer family
- Outstanding documentation and wide support

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  - Including:
    - 24 and 30 point Presentation fonts
    - All Tax Cartridge fonts
    - Full Roman-8 symbol set with all European language characters
    - All bar codes, OCR-B and much more
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- Outstanding documentation and wide support

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SUITABILITY TO TASK

Microtek MSF-300G

OCR:
Monospaced
fonts

OCR:
Proportional-
spaced fonts

Graphics:
Line art

Graphics:
Halftones

1   2   3   4

Microtek MSF-300Q

OCR:
Monospaced
fonts

OCR:
Proportional-
spaced fonts

Graphics:
Line art

Graphics:
Halftones

1   2   3   4

Microtek MSF-400G

OCR:
Monospaced
fonts

OCR:
Proportional-
spaced fonts

Graphics:
Line art

Graphics:
Halftones

1   2   3   4

These programs are almost identical, the major difference being that *PC GrayScan* is the one to use for gray-scale scanning. Both also work within *Microsoft Windows*. If you don't already own *Windows* (Version 2.10 or later) a runtime version of that graphical operating environment is included.

Because the Microtek scanners are controlled by *Windows*, they work with all *Windows*-supported video cards and printers. You can run both *EyeStar Plus* and *PC GrayScan* without a mouse, but you won't be able to perform all of the functions of the software; if you don't have a Micro-

soft-compatible mouse, you should get one and use it with these units.

We tested the Microtek scanners only for graphics scanning. The company sells *ReadRight*, a topological OCR software package, and the units will work with a number of other OCR programs. But because the OCR software is all provided by third-party companies, we stuck with graphics scanning. According to the vendor, *EyeStar Plus* and *PC GrayScan* will be combined into one package fairly soon, but for now you need to use *PC GrayScan* if you want to read gray scales.

The Microtek scanning software uses a two-window approach; "window," in this case, refers to scale of view. The Reduced View window, which by default is in the foreground, displays the entire scanned image. Normal View, in the background, is a dot-for-dot representation of the image—the equivalent of looking at the image under a magnifying glass. In Normal View you can display only a small portion of a scanned image at a time, but it's here that you can use the software's impressive selection of editing tools.

Before you scan, you can set resolution, scaling, brightness, contrast, and scanning mode and select from 12 different halftone patterns if you are using that mode. Microtek also lets you customize your own halftone pattern for different grains and effects. And you can set scanning speed from five different settings; the slower settings are advisable for tougher scanning jobs.

All of our testing was done with scanning velocity at the default medium setting. In order to choose just a part of an original for scanning, you can set coordinates or, more easily and perhaps more accurately, do what's called a prescan—a quick scan of the original—and then use a box tool to mark on the display screen the portion of the original you want to scan at higher resolution.

Once an image is scanned (and they all looked great on the test machine's EGA display screen), you can use the editing tools to spiff things up. The tools in *PC GrayScan* and *EyeStar Plus* are almost identical, with the exceptions that you can only manipulate individual bits in *EyeStar Plus* and that resizing takes place before a scan with *EyeStar Plus* and after a scan

Desktop Scanners: Summary of Features

(Products listed in ascending price order for hardware/software combination tested)

The following commentary analyzes some of the terms in this table of features. The phrases in bold type are listed in the same order as in the left-hand column of the table.

Number of bits per pixel A graphics scanner's number of bits per pixel is geometrically related to the number of gray-scale gradations it permits. A 4-bit scanner permits 16 levels of gray (2^4), a 6-bit scanner can accommodate 64 levels of gray (2^6), and an 8-bit scanner is capable of reproducing up to 256 levels of gray (2^8).

Paper path There are two main "document feed path" configurations for nonflatbed scanners. One is the C path, where, as the name implies, an original page is fed into the scanner horizontally, travels forward a short distance, and then curves up or down and around back along a parallel entry path across the scanner optics. The other design, an L path, is a vertical feed arrangement that drags the original into a horizontal path across the scanner optics.

Paper handling In some cases, the use of an automatic document feeder (ADF) allows larger sheets of paper to be accepted.

Interface characteristics Address selection and interrupts play a large role in configuring your system. Current AT and 80386 specifications (without separate driver routines) allow for very limited interface-board interrupt lines and addressing space. Of the 16 possible interrupts, only IRQ4 (COM1), IRQ3 (COM2), IRQ5 (LPT2), and IRQ7 (LPT1) can be used—and even then, only at the expense of the devices that would normally use the interrupt you've chosen.

Adjustable/automatic dithering Dithering translates the realm of gray tones into the strictly black-and-white dot environment of a printer. The scanner software adjusts the density of black dots within a given section of the scanned image so that it can appear to be at any of the available levels of gray. For most projects, automatic dithering will work quite

	Chinon DS-3000 Chinon America Inc. $995	Mitsubishi Heidfield Image Scanner SS-300+ Mitsubishi Electronics $995	ShapeScan Shape Inc. $1,290	Saba PageReader Sabe Technologies $1,295	Panasonic FX-RS505 Panasonic Industrial Co. $1,499	Ricoh RS320 Ricoh Corp. $1,499	Panasonic FX-RS506 Panasonic Industrial Co. $1,899	Hewlett-Packard ScanJet Hewlett-Packard Co. $1,990
HARDWARE								
Dimensions (HWD, including paper feed, in inches)	12.8 x 13.3 x 11.8	4 x 12.5 x 7.8	10.5 x 13 x 11.3	7 x 13.3 x 13	5.5 x 13.5 x 20.5	3.7 x 11.4 x 19.4	5.5 x 13.5 x 20.5	3.3 x 14.5 x 22.4
Physical capabilities								
Graphics scanner (number of bits per pixel)	●(1)	●(1)	●(1)	●(1)	●(4)	●(1)	●(4)	●(4)
Text scanner	●	●	●	●	●	●	●	●
Footprint (W x D, in inches)	13.3 x 11.8	12.5 x 7.8	10.5 x 13	13.3 x 13	12.5 x 16.5	11.4 x 19.4	12.5 x 16.5	14.5 x 22.4
Panel controls	Resolution, contrast, speed	Resolution	Contrast	Density	Resolution, contrast	None	Brightness, contrast	None
Paper path	Flatbed	L path	Flatbed	L path	Flatbed	Flatbed	Flatbed	Flatbed
Paper handling								
Maximum size sheet (inches)	8.5 x 11	8.5 x 14	8.5 x 14	8.5 x 14	8.5 x 14	8.5 x 11	8.5 x 14	8.5 x 11 (8.5 x 14 with ADF)
Minimum size sheet	None	3.2 x 5	None	3.5 x 3.5	None	None	None	None
Multiple-part forms accepted	●	●	●	●	●	●	●	8.5 x 5.5
Interface								
Proprietary interface card	●	●	●	●	●	●	●	●
Serial communications	●	○	●	●	○	●	○	●
Parallel communications	●	○	●	○	○	●	○	●
SCSI communications	●	○	○	○	○	○	○	●
Interface characteristics								
Board size	Half	Full	Half	Half	Full	Half	Half	Full
Selectable interrupts	●	●	●	●	●	●	●	●
Selectable address	●	●	●	●	●	●	●	●
SOFTWARE								
Memory-resident	○	○	○	○	○	○	○	○
Stand-alone software	●	●	●	●	●	●	●	●
Third-party software included	ReadRight	None	None	None	ScanDo	None	None	None
Help information on paper	●	●	●	●	●	●	●	●
On-screen help	●	●	●	●	●	●	●	●
Context-sensitive help	●	●	●	●	●	●	●	●
Software drivers								
Mouse	○	●	○	○	○	●	○	●
Keyboard	○	●	○	○	○	●	○	●
Light pen	○	●	○	○	○	●	○	●
Graphics tablet	○	●	○	○	○	●	○	●
Software capabilities								
Adjustable size/position of scan window	●○	●●	●○	○○	●○	●○	●○	●●
Adjustable/automatic dithering	○●	●●	○●	○○	○●	●●	○●	●●

▲ = Editor's Choice ● = Yes ○ = No N/A = Not applicable: this product does not support text scanning. N/A = Not applicable: this product does not provide graphics scanning.

well; the scanner software makes the decisions controlling the levels of black-dot density. Manually adjustable dithering gives you access to visual effects that would not otherwise be available.

Graphics editing A freshly scanned graphics image a seldom ready for immediate output. Even small revisions to clean up stray shades within the image require some form of graphics editor. No editor had the full range of features we looked for, although many of the scanned images could be imported into other applications that contained dot-level (bit) manipulation rather than the coarse block-select-and-edit features typically found.

File save characteristics OCR scanners depend on the application software that drives them. Among other things, this software is responsible for translating groups of consecutive spaces into tab characters within the output file, or removing a hard carriage return from the end of every scanned line that is not followed by a paragraph indent. In general, the smarter the input software, the less work you'll need to do.

File save format Whether the scanner is reading OCR or graphics materials, output is the key to its utility. And a variety of other applications are available to handle the output more effectively than the marginal software included with a scanner. One limi-

tation, of course, is the third-party software's ability to read in your scanner file. While proprietary formats for WordStar, Microsoft Word, or WordPerfect might be available, the more-generic ASCII format can be read by almost any word processor.

On the graphics side, the generic .IMG scanner format can be read by several applications, but it is slowly being replaced by the Aldus TIFF (.TIF) graphics file description format. Although more bulky, PC Paintbrush (.PCX) format files have also achieved near-universality. Application-specific graphics output—Windows Paint (.MSP) or Windows Draw (.DRW)—can be helpful only if you already have the right applications.

	DEST PC Scan 2020	Pentax SB-A4301 Image Scanner	DEST PC Scan 1020	Ceeon Image Scanner IX-12F	Microtek MSF-300G	Datacopy 730GS	AVR-302 Advanced Vision Research	AT&T Overview Scanner	CompuScan PCS	Microtek MSF-300Q	Microtek MSF-400G	Kurzweil Discover 7320	Xerox Model 5	Kurzweil K-5000
Vendor	DEST Corp.	Pentax Teknologies	DEST Corp.	Canon USA Inc.	Microtek Lab Inc.	Xerox Imaging Systems	Advanced Vision Research	AT&T	CompuScan Inc.	Microtek Lab Inc.	Microtek	Xerox Imaging Systems	Xerox	Xerox Imaging Systems
List price	$2,000	$2,195	$2,250	$2,335	$2,495	$2,690	$2,695	$3,050	$3,495	$3,495	$3,995	$4,995	$5,995	$15,950
Dimensions	4 × 16 × 11.5	4.2 × 15.5 × 20.5	3.3 × 14.5 × 22.4	14.5 × 21.5	5 × 15.5 × 24	3.5 × 11.4 × 19.4	5.2 × 15.9 × 20.1	15.5 × 13.5 × 14.5	13.5 × 25	5.8 × 15.5 × 24	5.8 × 15.5 × 24	5.8 × 16.3 × 10.8	13.9 × 23.3 × 20	
	●(8)	●(4)	●(4)	○	●(8)	●	●(1)	●	●(4)	○	●(6)	○	●(4)	
	16 × 13		15.5 × 20.3	14.5 × 22.4	14.5 × 21.5	13 × 15.5		15.9 × 20.1	8.5 × 13	16.5 × 18.5	13 × 15.5	13 × 15.6	18.3 × 10.9	23.3 × 20
	Flatbed or C path	Contrast, halftone / Flatbed	Flatbed or C path	Flatbed	Flatbed	Resolution, Contrast / Flatbed	Contrast / Flatbed	Flatbed	L path	Flatbed	Flatbed	L path	Flatbed	Flatbed
	8.5 × 14	8.5 × 11	8.5 × 11 (9.5 × 14 with ADF)	8.5 × 14	8.5 × 14	8.5 × 11.5	8.5 × 11	8.5 × 14	8.5 × 11	8.5 × 14	8.5 × 14		8.5 × 14	8.5 × 14
	8 × 8	None	None	None	None	None	5 × 7	None	5 × 3	None	None	5.3 × 4.3	4 × 5	
	○	●	●	○	●	●	○	●	○	●	●	○	●	●
	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	Half	Half	Half	Half	Half	Half	Full	None	None	Half	Half	Full	Full	
	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	None	GEM Scan		ReadRight			PC Paintbrush Plus	Dr. Halo		None	None	None	None	None
	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	●	●	●	●	●	N/A†	●	●	N/A†	●	●	N/A†	●	●
	●	●	●	●	●	N/A†	●	●	N/A†	●	●	N/A†	●	●
	●●	●●	●●	●●	○●	○●	●○	○●	○●	●○	●●	○●	○/○	●/●

(continues)

Desktop Scanners: Summary of Features
(Products listed in ascending price order for hardware/software combination tested)

	Chinon DS-3000 Chinon America Inc. $995	Mitsubishi Handheld image Scanner Mitsubishi Electronics $995	ShapeScan SS-300+ Shape Inc. $1,290	Saba PageReader Gaba Technologies $1,295	Panasonic FX-RS506 Panasonic Industrial Co. $1,499	Ricoh RS320 Ricoh Corp. $1,499	Panasonic FX-RS500 Panasonic Industrial Co. $1,899	Hewlett-Packard ScanJet Hewlett-Packard Co. $1,990
SOFTWARE								
Color recognition	●	○	○	○	○	○	○	○
Font matching/feature recognition	○/◐	N/A*	●/○	●/○	N/A*	N/A*	N/A*	N/A*
Range of font sizes (points)	6–12	N/A*	9–14	9–24	N/A*	N/A*	N/A*	N/A*
Font families must be preloaded	●	N/A*	●	●	N/A*	N/A*	N/A*	N/A*
Mixed text and graphics on same page	○	N/A*	○	●	N/A*	N/A*	N/A*	N/A*
Text editor/graphics editor	○/○	○/○	○/●	○/○	○/○	○/○	○/○	○/●
Graphics editing								
Manipulate bits/blocks	○/○	○/●	●/●	○/○	○/○	●/●	○/○	○/●
Resize image	○	●	●	○	●	●	●	●
Cut and paste	○	●	●	○	●	●	●	●
Copy select area	○	●	●	○	●	●	●	●
Paste into select area	○	○	●	○	●	●	●	●
Fill with solid	○	○	●	○	●	●	●	●
Fill with fixed pattern	○	○	●	○	●	○	●	●
Fill with selectable pattern	○	○	●	○	●	○	●	●
Draw lines	○	○	●	○	●	●	●	●
Draw figures	○	○	●	○	●	●	●	●
Enter and modify text	○	○	●	○	●	●	●	●
Rotate axis	○	○	○	○	●	●	●	●
Scale axis	○	○	○	○	●	●	●	●
Pick up colors or shades from image	○	○	●	○	●	●	●	●
Predefined colors or shades	○	○	●	○	●	●	●	●
User-defined colors or shades	○	○	●	○	○	○	○	○
Enhancement support								
Boldface	○	N/A*	○	●	N/A*	N/A*	N/A*	N/A*
Italic	○	N/A*	○	●	N/A*	N/A*	N/A*	N/A*
Superscripts/subscripts	○	N/A*	○	●	N/A*	N/A*	N/A*	N/A*
Underline	○	N/A*	○	●	N/A*	N/A*	N/A*	N/A*
OUTPUT								
Hard-copy output								
IBM 5152 Graphics Printer	○	○	○	○	●	●	●	○
HP LaserJet	○	○	○	○	●	●	●	●
PostScript printer	○	○	○	○	○	●	○	○
File save characteristics								
Spaces converted to tabs	○	N/A*	○	●	N/A*	N/A*	N/A*	N/A*
Hard carriage returns inserted (or removed)	●	N/A*	●	●	N/A*	N/A*	N/A*	N/A*
Paragraph markers inserted	●	N/A*	○	○	N/A*	N/A*	N/A*	N/A*
Programmable character substitution	○	N/A*	○	○	N/A*	N/A*	N/A*	N/A*
Programmable line spacing	○	N/A*	○	○	N/A*	N/A*	N/A*	N/A*
File save format								
Microsoft Word	●	N/A*	●	●	N/A*	N/A*	N/A*	N/A*
WordPerfect	●	N/A*	●	●	N/A*	N/A*	N/A*	N/A*
WordStar	●	N/A*	●	●	N/A*	N/A*	N/A*	N/A*
ASCII	●	N/A*	●	●	N/A*	N/A*	N/A*	N/A*
DCA	○	N/A*	●	●	N/A*	N/A*	N/A*	N/A*
.CGM	○	○	○	○	○	○	○	○
.DRW	○	○	○	○	○	○	○	○
.IMG	○	○	●	○	○	○	○	○
.MSP	○	○	●	○	○	○	○	○
.PCX	○	●	●	●	○	○	○	●
.PIC	○	○	●	○	○	○	○	○
TIFF	○	●	○	●	○	○	●	●
Proprietary	○	●	○	○	●	●	●	○
Other	Several WP formats	None	None	None	.PCC	Compressed TIFF	PCC, compressed TIFF	Compressed TIFF

▲=Editor's Choice ●=Yes ○=No N/A*=Not applicable: this product does not perform text scanning. N/A†=Not applicable: this product does not provide graphics scanning.

DEST PC Scan 2020	Pentax SU-A4301 Image Scanner	DEST PC Scan 1020	Canon Image Scanner IX-12F	Microtek MSF-300Q	Datacopy 730GS	AVR-302 Advanced Vision	AT&T Overview Scanner	CompuScan PCS	Microtek MSF-300G	Microtek MSF-400G	Kurzweil Discover 7320 Model 5	Kurzweil K-5000
DEST Corp.	Pentax Teknologies	DEST Corp.	Canon USA Inc.	Microtek Lab Inc.	Xerox Imaging Systems	Vision Research	AT&T	CompuScan Inc.	Microtek Lab Inc.	Microtek Lab Inc.	Xerox Imaging Systems	Xerox Imaging Systems
$2,000	$2,195	$2,250	$2,335	$2,495	$2,690	$2,685	$3,050	$3,495	$3,495	$3,995	$4,995	$15,950

8–12	6–24	8–12	6–12	N/A*	10–18	8–20	N/A*	10–12	N/A*	N/A*	8–24	6–24

.EPS | None | .EPS | None | None | Several WP formats | Hi- and low-res FAX | None | None | Several WP formats | None | None | Several WP formats | RES, UDS

(ends)

with the *PC GrayScan* program.

We haven't the space to list, let alone explain all of the editing tools Microtek supplies. The software cannot do as much as it can to edit colors or scale *z*-axis dimensions. But it can scale and rotate in 1 percent increments; cut, paste, and move around images; paint and draw with solids or patterns; and draw using a selection of tools like lines, rectangles, squares, circles, and ellipses.

Scanned images, edited or not, can be saved in TIFF, .IMG, .PCX, *Windows Paint*, and Encapsulated PostScript formats.

WHICH ONE TO BUY? The Microtek MSF gray-scale scanners are all serious tools, and the decision of which to choose should depend on your output needs. If most or all of your printing is done with a normal 300-dpi laser printer, for example, there's no reason to buy one of the G models; the 300Q will do just fine, still provid-

> The Microtek MSF
> gray-scale scanners
> are all serious
> tools; the decision
> of which to
> choose should depend
> on your output needs.

ing 64 gray-scale levels for printing on higher-resolution output devices if you need it.

If you produce a mixture of output—some on laser printers and some on phototypesetting equipment—the MSF-300G is a good compromise, with 300-dpi resolution and up to 256 shades of gray. Since gray scale and resolution have to be balanced anyway, this unit is a good choice.

If, however, most of your hard copy is on high-end printing devices and has to be of the very highest resolution with the

greatest number of gray levels, then Microtek's top-of-the-line MSF-400G is the one to choose, with its 400-dpi resolution and 256 shades of gray. Don't buy this unit if you don't need it, however, because the scans take somewhat longer and file sizes are bigger at the higher resolutions. If you can't see it or print it, why should you waste the time and disk space, not to mention the money?

Microtek continues to innovate and expand its scanning products. If this review reads like a testimonial, it's no accident: Microtek is doing a lot right.

—Bruce Brown

Mitsubishi Electronics America Inc.

There are myriad scanner types available—flatbeds, sheet-feeds, handheld scanners, and variations on each kind. If you've never used a scanner before, how do you select the right model? Even after you've identified a model that's most suited to your needs, there can still arise occasions when another scanner would be more suited.

Mitsubishi Electronics America must have had this in mind when it developed the scanner equivalent of the Swiss army knife. Simply referred to as the Handheld Image Scanner, manual operation is only

the beginning of the Mitsubishi Handheld Image Scanner's features. With an optional attachment, this functionally designed handheld scanner transforms into a compact sheet-feed model capable of reading a full 8½- by 14-inch document.

THE HANDHELD SCANNER Mitsubishi considers its scanner to be a three-in-one model. First, it's a handheld scanner with a sleek and easily held body; this basic device retails for $995, accompanied by an interface card, cables, and a graphics scanning program. For an additional $260, Mitsubishi sells the attachment that allows additional scanner functions; it's a sheet feeder with a flat paper path.

For $995 the attractive, 12½-inch Mitsubishi Handheld Image Scanner offers maximum functionality through minimal design. With an optional attachment, this functionally designed handheld scanner becomes a compact sheet-feed model capable of reading a full 8½- by 14-inch document.

Until Now, Ther Has Been A Lot Miss ng Frum Scanner Perform nce.

■ DESKTOP SCANNERS

The handheld portion snaps right over the top of the sheet feeder's paper entry. Once assembled, the entire apparatus is a featherweight at 3½ pounds and occupies a miniature footprint of 12½ by 8 inches. The power supply is completely derived from the interface card at the CPU.

The sheet feeder constitutes the second scanner type of the 3-in-1 design. The third scanner type is a flatbed model, which may not be apparent immediately. Basically, it is the feature set these combined products offer that resembles that typically found on flatbeds. The flat paper path of the sheet feeder allows heavier card stock to slip through without impairing paper finish—a benefit of flatbed models. The use of the handheld portion to scan materials from books or other oversize documents is another flatbed-type feature. And for scanning especially delicate items such as single carbon copies, credit-card receipts, and damaged paper (no problem for flatbed models), Mitsubishi provides a transparent holder to sandwich sensitive documents in prior to scanning.

Maximum functionality through minimal design: this theme surrounds the Mitsubishi Handheld Image Scanner. The theme even extends to the products accompanying image scanning software. Installation is truly a matter of minutes. The entire program is contained on just one 360K

diskette and is installed by copying its files to the hard disk. Normally, this method of software installation conjures up visions of some crudely written, command-oriented program. On the contrary: with no further installation, you are presented with an elegant graphical interface of the GEM/Windows genre, complete mouse support, and automatic recognition of expanded memory.

If it weren't for the efficient disk/memory caching technique used to expedite the scanning process, it would be possible to run this application on a two-floppy-drive system. Instead, it will run on a PC, but there must be a hard drive with 1.2MB of free space. When memory is available, the software buffers the image as it scans, which produces full-page scan times remarkably close to the manufacturer's own specification sheet—approximately 10 seconds. When additional memory is unavailable, the software will automatically write the image temporarily to disk as it scans, to simulate the buffering process. Even in this case, scan times are not sluggish.

IMAGE SOFTWARE The image software supports both PC Paintbrush and TIFF file formats. Graphics editing tools include flip, rotate, erase, and zoom, and all operations are performed swiftly with both line art and photo images supported. While the software does not recognize gray scales, an automatic 16-level dithering process is invoked to simulate them when you choose halftone as the scanned image format; resolution is automatic and limited to 200 dpi (dots per inch). Output both on-screen and at the printer are quite acceptable, considering the resolution.

No OCR support is currently offered, but the manufacturer does plan to provide drivers for third-party manufacturers of text-scanning software. No products have officially been targeted for this yet, nor have any dates been announced.

The Mitsubishi Handheld Image Scanner is not the least-expensive scanner on the market, and without OCR its capabilities are still limited. But its attractive and functional design of both hardware and software and its ease of installation and use make it a smart system to consider.—**Tami Peterson**

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Panasonic Industrial Co.

"Simple is better." "If it works, leave it alone." "Focus on your real needs and don't get distracted by frivolous features." The common theme of these simple truths, heard often from the lips of experienced computer users, is the emphasis on function as opposed to frivolities and mere possibilities.

Panasonic must have had something similar in mind when designing the scanners we tested. Each of the company's two reasonably priced, high-resolution scanners, the $1,499 Panasonic FX-RS505 and $1,899 FX-RS506 flatbeds, comes with a different, but limited, graphics scanning software package.

While these programs are limited in editing and hard-copy output capabilities, each lets you save image files in at least three popular formats. Both programs are easy to use. If you want to edit the image files or if you need OCR capabilities, though, you'll have to use third-party software. What Panasonic hasn't done is force you to pay for functions you might not need anyway.

Equipped with a 4-bit mode for reading 16 levels of gray scale and a half-length card that comes in handy if full slots are scarce, the $1,899 Panasonic FX-RS506 is a competitive, functional scanner with all frills sold separately. Its graphics-scanning program, called ScanDo, runs under Microsoft Windows.

SUITABILITY TO TASK

Panasonic FX-RS505

	1	2	3	4
OCR: Monospaced fonts				
OCR: Proportional-spaced fonts				
Graphics: Line art				
Graphics: Halftones				

Panasonic FX-RS506

	1	2	3	4
OCR: Monospaced fonts				
OCR: Proportional-spaced fonts				
Graphics: Line art				
Graphics: Halftones				

Externally the units are the same, measuring 13½ inches wide by 20½ inches deep by 5½ inches high, and each weighs 17.2 pounds. Both feature removable covers to accommodate huge originals on the scanning bed; the maximum scanned area is 8½ by 14 inches.

The FX-RS505 and FX-RS506 use different proprietary interface cards, and cables are included. Either card works in an 8-bit interface slot; the only difference is that matters to you is that the less-powerful FX-RS505 uses a full-size card, while the FX-RS506's card is only half-length—a convenience if full-size slots are scarce in your computer. Installation and configuration, you'll find, are a breeze.

As the lower-priced unit of the two, the FX-RS505 doesn't do gray scale and can't be expanded with an automatic document feeder like its pricier sibling. The FX-RS505 can, however, emulate 16 levels of gray scaling with dithering. Graphic scanning functions on the FX-RS505 are controlled through *PanaScan*, a simple, menu-driven program.

The FX-RS506 has a 4-bit mode for reading 16 levels of gray scale. Its graphics scanning program, called *ScanDo*, runs under *Microsoft Windows*. If you're going to do much OCR work at all (any OCR requires a separate program for the purpose), the FX-RS506 with a 30-page-capacity automatic document feeder, a $649 op-

tion. So it will cost you around $3,000 including software if you want to fully outfit the FX-RS506 to capture text and graphics. That price is still competitive with other units, but the nice thing about it all is that the components are unbundled: you have to buy only what you need.

THE FX-RS505 The FX-RS505 will work at three resolutions: 200, 300, and 400 dpi (dots per inch). All settings and operation are controlled through *Pana-Scan*, which works with cursor keys or a mouse using old-fashioned vertical menus. *PanaScan* offers all four major functions: scan, parameter setting, view, and save. Note that there's no way to print hard copy.

Scanning parameter settings include resolution, line art, or halftone mode, seven levels of brightness, two types of halftone dithering, regular or reverse mode, and page size. Page size choices are letter, legal, invoice, and custom. You set the custom page size either by typing the dimensions into a margin menu or by dragging a mouse around a visual representation of the scanner bed, with margin sizes showing up on the margin menu.

You can look at a scanned image and zoom to different levels, but you can't edit an image with *PanaScan*. The on-screen representations of image scans are only average with the FX-RS505; the images are

actually better than they look. But you can save all or part of a scanned image in .PCX, .PCC, or TIFF format.

Using an 8-MHz AT, the FX-RS505 took between 28 and 49 seconds to scan a page, depending on mode and resolution. Saving scanned images in .PCX format took between 19 and 300 seconds—again depending on settings—with highest-resolution halftone mode taking the longest time by far, as expected. Keep in mind that since resolution and gray scaling need to be balanced, typical halftone scans would not be run at highest resolution. 300-second saves, in other words, don't reflect real-world situations.

If you want to scan line art and have only limited needs for gray scaling, the FX-RS505 is an inexpensive but certainly adequate choice.

THE FX-RS506 Of the two Panasonic models, the FX-RS506 is the better choice if you want gray scaling or the ability to conveniently do OCR work now or at some point in the future. Using 4-bit graphics, the FX-RS506 can capture up to 16 levels of gray scale. It also has more resolution levels, with settings for 50, 75, 100, 150, 200, 300, and 400 dpi.

Externally, the FX-RS506 looks like the FX-RS505. And both will work with third-party OCR software. But the more-expensive unit can also take the document-feeder option, giving you the best of both worlds—with a flatbed to handle a variety of originals, including pages in books and thick or large-format sources, and the convenience of automatic document feeding for OCR work.

ScanDo, the software that runs the FX-RS506, works in *Microsoft Windows*, and if you don't already have *Windows* you're still set to go, because *ScanDo* comes with a runtime version. Although *ScanDo* doesn't require a mouse, it's easier to work with one, especially for dragging around the screen to grab part of a scanned image.

The *ScanDo* interface is pleasant to work with, but the only functional improvements over *PanaScan* are a Quick-scan feature (to mark off a portion for a second scan), and some controls to help size the result of a scanned image input. The other significant tool is a black-and-white brush for minimal image editing. With *ScanDo* you can save images in .PCX, .PCC, .MSP, and both TIFF and TIFF-compressed formats.

On-screen scanned images look significantly better with the FX-RS506 than with the FX-RS505, but you still need other software to print them or to do extensive editing. Scanning in gray-scale mode, especially with a high-resolution setting, can take a long time—the longest we had was just under 3 minutes to scan a full page in gray-scale mode at 400 dpi. The resulting 3MB file took more than 16 minutes to convert to and save in .PCX format.

The FX-RS506 works easily and well. You could spend a lot more money for similar or less functionality. If you add the price of the document feeder, OCR software, and image editing software to the FX-RS506's $1,899 list price, you'll still be spending less than with most other scan-

ners that possess similar abilities.

Scanner technology is coming of age for personal computing. If you need to read in graphics for editing and manipulation with other software, and if you don't really need the umpteenth level of gray scaling and resolution, the Panasonic scanners might just do it. From my lips to your ears: these two work. Check them out.
—Bruce Brown

Pentax Teknologies

If form is as important to you as function, take a good look at the new Pentax SB-A4301 Image Scanner. Its slick gray aerodynamic styling drew *oohs* and *aahs* when we pulled the unit from the box, and its graphics scanning and OCR performance confirmed that it's more than just a pretty face.

The system we evaluated used *GEM Scan* as its graphics scanning software running under Digital Research's graphical environment, included in the package. *GEM Scan* offers a truly superb and easy-to-use scanner interface, but no support for the scanner's 4-bit gray-scale scanning capability (16 levels of gray). Pentax buyers who plan to use their scanner with a desktop publishing system supporting gray scale will miss an important

Although the scanner is not yet offered with software supporting its 4-bit gray-scale capabilities, slick design and scanning performance make the $1,465 Pentax SB-A4301 Image Scanner a powerful combination of beauty and brawn.

piece of the puzzle until Pentax provides a driver for software supporting gray scale, as is expected in the near future.

GEM Scan's gray-scale stumble is unfortunate, because it provides such an outstanding, intuitive software interface for line art and dithered scanning. If your present needs do not include gray-scale scanning, you'll be very happy with the Pentax/*GEM Scan* combination.

THE SB-A4301 AND GEM *GEM Scan* duplicates the essential scanning commands on its drop-down menus as easy-to-understand icons on-screen. That makes such operations as choosing between high and low resolution and line art or halftone scanning as simple as point and click. With just a few mouse clicks, you can run a low-resolution scan, frame the area to rescan, and then switch to high-resolution scanning to produce a *GEM*-format .IMG or TIFF output file. *GEM Scan* also provides precise control over brightness, contrast, and a fine-tuning halftone control (explained poorly in the *GEM Scan* manual) called gamma level. Our photo, scanned at 300 dots per inch, fared extremely well with the Pentax/*GEM Scan* combination, receiving a flattering array of dithered pseudograys.

The Pentax software's emphasis is on ease of use, and the optional OCR software, another *GEM* application called

Synergy UK, is just as elegantly designed and delightful to use as *GEM Scan*. *Synergy UK*'s main screen displays three large buttons: Start OCR, Set OCR Parameters, and Save Parameters. You can perform a very fast low-resolution prescan of your document and then select up to six scanning areas on each page under Set OCR Parameters. Then, you can scan each area in succession, saving each as a separate

ASCII text file if you wish.

Synergy UK comes trained for two fonts: Helvetica and Courier. On our test Courier page, *Synergy UK* worked quickly and did a respectable job, though it failed to meet the high level of accuracy of some of the better OCR scanners, such as the

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DEST models. The *Synergy UK* software is so easy to use that I tried training it to read some of the more-unusual proportionally spaced fonts in our test. Like many other OCR software packages, *Synergy UK* bombed out with tightly kerned character pairs, interpreting both characters as a single one.

A Pentax official reports that the software supplied with the scanner will soon run under *Microsoft Windows*, as an optional alternative to *GEM* (both will be supplied). Though it is hard to imagine a more-friendly interface than *GEM Scan*, the new software should realize both the bilevel and gray-scale capabilities of the scanner. At that point, the scanning software will match the prowess of Pentax's impressive hardware. —**Stephen Sagman**

Ricoh Corp.

Henry David Thoreau said, "Life is frittered away by detail . . . Simplify, simplify." Here's a scanner that takes Thoreau's message literally. The $1,499 Ricoh RS320 is a simple-to-use, no-nonsense graphics scanner. What has been

sacrificed for all this simplicity? Well, some of the features found on the other scanners in our review. But plenty of features are there to enable you to produce quality graphics images.

You can increase your dots-per-inch resolution, for instance, from a low of 60, all the way up to 360 (though photograph mode quarters your dpi, for a maximum of 90). You can adjust the brightness directly from the scanner or from the *ScanDo* program. "Drop-out" colors for the RS320 are yellow and light blue. No, these aren't the high-school hues for people without diplomas—they're the colors the scanner can't detect. Should you desire to dither about, *ScanDo* (third-party graphics software also provided with Panasonic's models) gives you three options: spiral halftone, fatting halftone, and random halftone. There's also *ScanDo's* Quick Scan method that lets you bring in an image, then do a higher-resolution scan on whatever section you choose.

WHAT SCANDO CAN DO The RS320 is used with the Ricoh Scanner PC Interface Kit, consisting of the scanner interface board, cable, *ScanDo* software, and manual. The half-size board arrives already configured for *ScanDo*; if you use anything else, you'll have to reset some jumpers.

ScanDo requires *Microsoft Windows* Version 1.03 or later. For those already fa-

miliar with *Windows*, the interface is very straightforward. The tutorial in the manual will get you up and running quickly. And Ricoh will be shipping *GEM Scan*, with a runtime version of *GEM*, from Digital Research with the RS320 by the time this article is published. Purchasers will then have

SUITABILITY TO TASK

Ricoh RS320

the option of getting either *ScanDo* or *GEM Scan*. (Those who already have the RS320 may request and get *GEM Scan* free.)

ScanDo allows you to zoom, scroll, or reach into the tool box, if you prefer, for a paintbrush to touch up your image. The few unperfect souls among us will appreciate the Undo command. Switching of images can be selected with either the Mirror or Inverted choices; possible image types are line art, photograph, the three dithering halftone selections, and the outline func-

A classic example of how a scanner can achieve simplicity without sacrificing basic quality. the $1,499 Ricoh RS320 scanner offers high resolution as well as brightness control. Using the popular ScanDo and GEM Scan software, the RS320 makes a promising addition to a publishing package.

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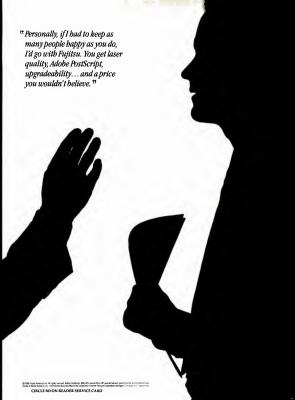
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tion for solid images. Other options include scanning in inches or millimeters, and drawing in replace, mask, or merge. Replace, the default, does what you think it does—replaces your image wherever you use it. Mask and merge are different animals. Neither works with line art, but both can be used on photograph and dithered-mode images to darken or lighten the image.

Want to save time in scanning? Use the fixed or variable extraction ability of the RS320, called the Location option in ScanDo. Scanning can be done on only the area you want to see, eliminating all that white space as well as the time it takes to scan it.

WHAT SCANDO CAN'T DO The Ricoh RS320 has at least one function that ScanDo doesn't do: framing. This software-dependent feature allows you to specify a border around your photograph or illustration. Also, ScanDo allows only three density options, not all 16 possible on the RS320.

There's also a lot of tweaking ability missing that another software package may soon allow. Ricoh will sell you the optional PublishDo, when it's released, if you want to invert, rotate, move, or copy your file. PublishDo is also expected to allow freehand, line, box, and circle drawing, in addition to other features. The software will allow you to run GEM Scan, giving you some functionality as well as .GEM file creation. But you'll lose .PCX and .MSP formats. Want OCR? The Ricoh RS320 is supported by PC OCR, Carte's, SmartStart, Advantek, and Spot, though none is supplied with the other.

The Ricoh RS320 is a simple scanner with some nice features. This scanner would be a fine adjunct to a desktop publishing package, for those serious about getting images into their work. Just be sure your desktop publishing package accepts the files generated by the scanner software you use. The Ricoh RS320's price is comparable with those of the others looked at: $1,499 for the scanner and interface kit. But if you want to do any serious editing of your scanned image, you'll probably want to wait till you can get the functionality of PublishDo as well.

—Pamela J. Milland

Saba Technologies

The Saba PageReader from Saba Technologies is a compact, sheet-feed scanner. Its small size and light weight do not prevent it from reading a full legal-size document. And its straight paper path allows paper as heavy as card stock to slip through without affecting the resulting image or the paper itself.

The PageReader, accompanying software, adapter card, and cable retail for $1,295. Unlike most scanners with both text and image capabilities, all scanning in the PageReader is performed within the same software program; this feature means you have to learn only the one application.

INSTALLING THE PAGEREADER Scanner and software installation is done in just a few minutes. Once installed, the simple software interface eliminates any serious effort or complication from scanner operation. Just choose a text or graphic file format from a pull-down menu, give the file a name, and go scan. If scanner operation is new to you, help is available for each of the menu options, and a full tutorial is included with the documentation.

The Saba PageReader offers a variety of word processing formats in which to save scanned pages or text. These include Microsoft Word, MultiMate, and WordPerfect, as well as ASCII. But there's more: a direct import to the Lotus 1-2-3 spreadsheet format. Printed numerical data, in tabular format, can be scanned and then transformed into appropriate columns and rows that a spreadsheet will recognize.

Saba PageReader

SUITABILITY TO TASK								
OCR: Monospaced fonts								
OCR: Proportional-spaced fonts								
Graphics: Line art								
Graphics: Halftones								
	1		2		3			

PageReader automatically eliminates dollar signs and commas as it brings in the numerical data—this is the way 1-2-3 actually stores numbers within its cells. Text encountered on the same page would be assigned a text value in the 1-2-3 spreadsheet. None of our tests included importing numerical data, so we cannot attest to

Don't be fooled by the small size of the sheet-feed Saba PageReader. It can still read full legal-sized documents—and even spreadsheets—and its straight paper path allows it to scan images on paper as heavy as card stock. Not directly targeted at the desktop publishing market, this easy-to-use $1,295 OCR represents a bargain for everyday business needs.

It Takes Guts To Turn A Laptop Into A Desktop.

Most desktop computers are entirely too big and too clumsy to make it off the desk, to say

Two IBM-compatible internal expansion slots let you expand the T3200's capabilities quickly and easily.

nothing of making it out of the office.

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A separate numeric keypad speeds data entry.

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the integrity of this format. But Page-Reader was among the few to offer spreadsheet format as a text option.

The Saba PageReader is one of the few scanning products not directly targeted to the desktop publishing market. The emphasis, rather, is on low-cost, ease-of-use OCR for everyday business needs. The PageReader isn't designed to read more than one font style per page, which is suitable for most common documents, proposals, reports, and other business documents. In addition, the PageReader's font-recognition capability for such standard typestyles as Courier may require some additional training to match exactly the variations in output by your particular typewriter or printer—specifically with regard to punctuation marks. Misreading punctuation is where the Page-Reader lost the majority of its points in our tests. Otherwise, the potential is definitely there for this scanner to make an impact in its targeted market.

SEVERAL GRAPHIC FORMATS
While low-cost OCR is this product's emphasis, it does provide several graphic formats to save scanned line art. These include TIFF, Lotus .PIC, and nearly all varieties of the *PC Paintbrush* .PCX format, from black and white to 16-color EGA. Input and output resolution are automatic and limited to 200 dots per inch. And although the PageReader will save an

Handy scan.

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For product information or nearest authorized Mitsubishi Electronics sales representatives, please call 1-800-556-1234, ext. 54H. In California, call 1-800-441-2345, ext. 54H. Mitsubishi Electronics America, Inc., Computer Peripherals Division, 991 Knox Street, Torrance, CA 90502, (213) 217-5732.

The scanner, model SP-MH236AF, can scan an 8½" x 11" page in 30 seconds, independently or with an optional automatic paperfeeder, model SP-MH49PA, shown above.

CIRCLE 371 ON READER SERVICE CARD

▲ MITSUBISHI
ELECTRONICS

MITSUBISHI

Actual Size

image to a number of color-compatible formats, this scanner is strictly black and white and does not recognize color even to turn it into black and white. In fact, Saba does not recommend scanning photographs or gray-scale images. In the manual, the company offers the general rule, "If your drawing photocopies well, it will probably also scan well."

PageReader is a project-oriented system. If the contracts you scan, for instance, are always in 12-point Prestige Elite, are saved in *WordStar* format, and are stored in the CONTRACTS directory, PageReader allows you to save these settings under a project name. The next time you need to scan contracts, just load the scanning parameters by selecting the previously saved project file.

In line with its commitment to the OCR market, PageReader provides exceptional control over word processing text for a scanner in its price range. There are underline, soft hyphen, line spacing, margin, and tab controls. Alignment controls are included to designate a paragraph's justification, such as centered. Tables, indents,

PageReader provides exceptional control over word processing text for its price.

and even outdents can be converted to tab positions. For each word-processing format supported, the PageReader manual provides a complete description to assist you in establishing these settings for your documents. The same meticulous descriptions are documented for special characteristics of the Lotus file format as well as all graphic files supported. Clear, well-written documentation is definitely an asset here.

PageReader can be considered neither a low-end nor high-end scanner, based on its capabilities, while its pricing decidedly places it near the bottom of the scanning market. So if your OCR needs lean toward

repetitive entry of consistently typed or printed documents, this scanner could be a real bargain.—*Tami Peterson*

Shape Inc.

For entertainment, set the ShapeScan SS-300+ in front of a group of PC users and watch them try to guess what it does. Its bemusing cube shape makes it look more like a small microwave oven than a capable and surprisingly inexpensive 300-dot-per-inch text and graphics scanner.

Lift the unit's double-folding lid, and you'll find a curved-glass scanning platen that keeps even the farthest lengths of an 8½- by 14-inch document equidistant from the bottom center of the cube, where the scanner's optics reside. On the platen, you can position photos, papers, and magazines. The SS-300+ *Scan* software successfully scans line art and photographs and produces either bilevel (black-and-white) or dithered .PCX files. Gray-scale scanning, though, is still in the realm of more-expensive scanners. Z-Soft's *PC Paintbrush Plus* comes with the ShapeScan SS-300+ for comprehensive image editing.

For an additional $495, you can add a ShapeScan-specific version of Pattern An-

alytics' *Carets* OCR software. *Carets* reads more than three dozen monospaced and proportional-spaced typewriter, laser printer, and dot matrix printer fonts, translating the files that result into ASCII text or seven different word-processing file formats.

SETTING UP THE SS-300+ Setting up the ShapeScan SS-300+ hardware is easy. Unlike much scanner software, Shape-Scan's direct-to-disk *Scan* program requires no expanded memory. The Shape-Scan connects to its half-size PC interface card with a flashy multicolored ribbon cable. Setting up the software is a

SUITABILITY TO TASK

ShapeScan SS-300+

OCR:
Monospaced
fonts

OCR:
Proportional
fonts

Graphics:
Line art

Graphics:
Halftones

1   2   3   4

For less than half the price of many of its competitors, Shape's $795 ShapeScan SS-300+ scanner offers one alternative for low-cost publishing in a home or small-office environment. Its Scan program requires no expanded memory, and the optics, located in the bottom-center of the cube, scan line art and photos to produce either black-and-white or dithered files.

bit more difficult, though. Installing a special driver for the scanner requires several modifications to the CONFIG.SYS file. While these are minor (there's no automatic batch file to do the job), they're complicated enough to impede the SS-300+ in its ideal calling as a tool for infrequent use by computer neophytes. To install the SS-300+, you'd better know how to add commands and parameters to a CONFIG.SYS file: the documentation gives no step-by-step instructions.

The ShapeScan SS-300+ proved slower than several other scanners in our test, so for high-volume scanning, the extra time to scan each image with the SS-300+ (from 45 seconds to almost 2 minutes, depending on the image) makes opting for a more-expensive but faster scanner a good idea. For desktop publishing, the SS-300+ offers no gray-scale scanning. Instead, it dithers images. But for occasional use—say, to scan the photographs for a weekly newsletter—the SS-300+ is a fine alternative for low-cost publishing.

While trying to read our best printer output used in our text scanning test, the unit's optional *Carets* software failed to approach the accuracy of better OCR systems, such as DEST's OCR software. This

was true even with the slower Check Features option, which more thoroughly verifies characters to improve reading accuracy. *Carets* comes pretrained for a wide range of typefaces, from IBM Selectric typewriter type to dot-matrix-printer output, and it has the capacity to learn other fonts. If your main goal is text scanning, though, some of the more-capable OCR systems in our survey would be a better bet. In addition, if you need to *Scan* text in high volume, you may prefer a scanner that can accommodate a sheet feeder.

The most-expensive scanners promise more than they deliver for the buck, but the unconventional ShapeScan SS-300+ delivers more than you'd think for its modest price. While it lacks gray-scale scanning, a sheet feeder, and the speed of some other scanners, it's far less than half the price of many. That makes the product well-suited for occasional use in home or small-office environments, or even for one with a fax board, particularly in a system lacking a gray-scale VGA and expanded memory. But if your intention is to avoid a scanner with comprehensive capabilities to a busy desktop publishing system, you'll have to forego the ShapeScan unit and its low price to get the features you need.
—Stephen Sagman

Xerox Imaging Systems

Of Kurzweil Computer Products and Datacopy Corp., the latter is not widely associated with the Xerox name; both Kurzweil and Datacopy, however—along with their wide selections of scanning products—are owned by the Xerox Corp. While their product lines are now handled by the new Xerox Imaging Systems subsidiary of Xerox, all products, including the three evaluated here, continue to carry the brand names of their former owners.

The $1,300 Datacopy 730GS, introduced around the time the new Xerox subsidiary was formed, is a flatbed model equipped to scan both text and graphics images. For an additional $695, you can receive a proprietary interface board and *PC Image*, a graphics scanning program. To import text through the scanner, an additional $695 will get you *OCR Plus*.

The $4,995 Kurzweil Discover 7320 Model 5 is a text-only scanner, targeted at

professionals who have general business needs and low volume requirements. Its font-recognition range is from 8 to 24 points and provides three levels of contrast control.

If automotive comparisons were to be drawn among the Kurzweil K-5000 scanner and others in this review, the K-5000 would be the Cadillac—both in price and performance. While its scanned samples are excellent, the K-5000 wears a hefty $15,950 price tag that's guaranteed to cause financial palpitations in all but the most-devout scanner aficionados.

Although its $15,950 price tag is formidable, the Xerox Imaging Systems' Kurzweil K-5000 is indeed a masterpiece. Its abilities to scan bound pages and large manuscripts quickly and to provide excellent scanned images make this machine truly a top-of-the-line product.

FACT FILE

Xerox Imaging Systems
185 Albany St.
Cambridge, MA 02139
(617) 864-4700

Datacopy 730GS
List Price: $1,300; *PC Image* and interface board, $695; *OCR Plus* software, $695; *OCR Plus* with interface board, $895.
Requires: 640K RAM, 286 or 386 machine, hard disk, graphics adapter, DOS 2.0 or later. Mouse recommended
Supports: All graphics adapters, input and output devices supported by *Microsoft Windows*. *PC Image* is accompanied by a run-time *Windows* program.
In Short: This scanner is equipped with true gray-scale software that is intended for use on advanced hardware. A 386-based machine should be used for maximum performance. The product's OCR capabilities are middle-of-the-road (and treating may be required on proportional-spaced type); however, upcoming software that supports this model's 6-bit gray-scale graphics may make this one worth the wait.
CIRCLE 422 ON READER SERVICE CARD

Kurzweil Discover 7320 Model 5
List Price: With proprietary interface card, cabling, and text-scanning software, $4,995.
Requires: 640K RAM, hard disk, PC-XT or AT, DOS 3.0 or later.
Supports: No special devices supported; printing is done through word processor.
In Short: If your text-scanning needs go beyond monospaced fonts, this scanner's relatively high price tag is appropriately weighed along with its ability to recognize proportional fonts with a high degree of accuracy. Among its functions is included the ability to automatically disregard graphics that appear within text.
CIRCLE 423 ON READER SERVICE CARD

EDITOR'S CHOICE

Kurzweil K-5000
List Price: With automatic document feeder, proprietary coprocessor board, *ICR/HAR* character and graphics scanning software, recognition software for seven languages, and cables, $15,950; *Interleaf 2.0* Option Kit, $495.
Requires: 512K RAM (640K RAM recommended), hard disk, DOS 3.0 or later.
In Short: A premium scanner with a premium price tag, the Kurzweil K-5000's combination of text and graphics capabilities is unbeatable. Nothing else on the market today, in terms of performance for a price, can match it.
CIRCLE 424 ON READER SERVICE CARD

DATACOPY 730GS For image scanning, the 730GS uses *PC Image*, which runs under *Microsoft Windows* or an included runtime version. The runtime version provides the essential graphical user interface that allows *PC Image* to operate. The software then acts as a standalone application.

In addition to offering true 16- or 64-gray-scale image interpretation, the 730GS offers 27 different resolution values from 60 to 450 dots per inch. But stand forewarned: a 450-dpi, 64-level-gray-scale, full-page image is going to require more than 23 minutes to scan and demand just under 20MB of disk space to save. So unless you have a real need for scan an image, you're better off sticking to the lower-resolution options. A photo scanned with a 16-level gray scale and 60 dpi will take just over 1 minute to scan and less than 20 seconds to save.

To preserve any image with gray-scale settings, *PC Image* offers four different file formats: Datacopy's own proprietary .IMG, TIFF uncompressed (.TIF), GEM image (.IMG), and *PC Paintbrush* (.PCX). For line art, and to save images without their gray-scale settings, there's TIFF compressed (.TIF) and *PC Paintbrush* (.PCX).

After seeing the quality *PC Image* is capable of extracting from the 730GS, you may be willing to endure the higher-than-average scan times. Output quality of both line art and images from the Datacopy

730GS was certainly among the highest of all the graphics scanners tested.

PC Image provides a variety of software controls to manage the appearance of a scanned image. There are 16 brightness controls, four contrast settings, and numerous halftoning patterns like user-definable patterns and edge detection to simulate fine art.

Also included are some limited graphics editing tools like bit manipulation, resize, copy, cut, and paste. To do further editing, Xerox Imaging Systems recommends you take the images to a program like *PC Paintbrush Plus* or *Publisher's Paintbrush*, which can also be purchased along with the scanner. The company also highly recommends using its *PC Image* software on a 386-based machine to quicken scanning, saving, and file-retrieving times.

DATACOPY ON TEXT We also tested the Datacopy 730GS for its text-scanning abilities. Using the included *OCR Plus* software, the 730GS produced results comparable with other scanners not employing the more-advanced character-recognition methods.

OCR Plus uses a pattern-matching method supplemented by a topological technique. Character learning, one of the software's features, is a real plus for when the font you need is not specifically supported. But a variety of typical office typewriter and printer fonts are supported, in

■ DESKTOP SCANNERS

For general excellence in both graphics scanning and OCR, Xerox Imaging Systems' Kurzweil K-5000 is unmatched. Designed for high-production work—done in the background when you're scanning text—the K-5000 proves without a doubt that the brains behind its hardware—ICR (intelligent character recognition)—is more than simply marketing hype. Quick, near-perfect text reads and crisp scanned images distinguish this product.

You may not be prepared to spend $15,950 even for this kind of functionality, or may not need quality work with both text and graphics. If that's the case, take a look instead at the $2,335 Canon Image Scanner IX-12F or the $995 Chinon DS-3000.

While we tested the Canon only for its OCR capabilities (graphics scanning software is unavailable except through third-party companies), the Canon performed well in this category on our mid-sized monospaced Courier and proportional-spaced Helvetica samples.

Possibly because of its overhead design, the Chinon DS-3000 is not

the recommended choice for optical character recognition; quick work yielded lackluster results. But no such mediocrity tarnishes the Chinon's graphics scanning. For $100 less without OCR capability, this system offers fast graphic scans, 16-level dithering that beats the gray scaling of most competitors, and a bundled DTP program called Publish It!

Surprisingly, both the Canon and the Chinon use the same OCR program, ReadRight: a testimonial to the importance of hardware design in scanner performance.

Keep in mind while shopping that specialized applications make a great difference in your choices. The AT&T Overview Scanner, though not intended for graphics output, offers exceptional images on-screen, which can then be added to an image database. The Saba Page Reader is notable for its ability to scan Lotus 1-2-3 spreadsheets. And the Mitsubishi Handheld Image Scanner can act as either a sheetfeed or a handheld scanner if desktop space or portability is a consideration.

sizes ranging from 10 to 18 points.

In tests limited to 10-point Courier, the Datacopy 730GS performed on a par with other scanners. But many of these tests were geared to proportional fonts and mixed sizes, and here, the 730GS using OCR Plus was not as successful. Although the software claims to read proportional-spaced fonts, it may need further training to interpret the typeset-quality versions output by most laser printers.

The Datacopy 730GS, with its high-end gray-scale support is worth considering, for a total of $1,995 with PC Image and an interface card. But while the gray scale in its PC Paintbrush (.PCX) image format is not widely supported yet by other application software, because of its complexity, verify that your intended application provides support before you expand the time and disk space on this particular format. If your main priority is text scanning that's not limited to the basic monospaced fonts, you might consider another scanner from Xerox Imaging Systems—perhaps a Kurzweil model.

KURZWEIL DISCOVER 7320
Kurzweil is associated with the high-end text-scanning technology it calls ICR (intelligent character recognition). This topological approach incorporates a more-sophisticated architecture, based on artificial-intelligence techniques. The bottom line: when most scanners use the more-common OCR technology of pattern matching, ICR allows the Kurzweil scanners to read thousands of typestyles in sizes ranging from 6 to 24 points.

This level of technology, remarkably accurate at turning the contents of a page with varying fonts into a reasonably managed text file, does not come without a commensurate price tag. The Kurzweil Discover 7320 Model 5 is the lowest-priced scanner incorporating ICR offered by Xerox Imaging Systems (there are a number of other scanners in the Discover 7320 line, such as the Model 30), but it still retails for just under $5,000.

The scanner's price is justifiable on the basis of the variety of typestyles it can handle. While most scanners are unequipped to intelligibly read fonts other than the monospaced styles—specifically 10-point Courier—the Kurzweil scanner offers tremendous value when matched with a user requiring proportional-font input. Of all the scanners tested, the Discover 7320 comes closer to providing the kind of results most people tend to expect from a text scanner.

When a Kurzweil scanner encounters difficult text, it doesn't pause to whine about it, or—worse—throw in error characters recklessly, as many text scanners do. Instead, what the Kurzweil can't read, it ignores, and then it goes on with its business. Retaining the unreadable text in memory, it makes periodic trips back to the previously illegible characters and attempts to replace them with the most-logical substitutes based on an assessment of the text as a whole.

A proprietary coprocessor board with 2MB of board RAM provides the memory and speed necessary to drive this "intelligent" scanning device. Its software, also included in the $4,995 retail price, is easily installed and used; 16 word-processing formats are directly supported as well. And the scanner itself will not invade your desk space. With a relatively tiny footprint (16

■ DESKTOP SCANNERS

by 10¾ inches), this scanner is easily placed alongside the computer for effortless scans on a moment's notice.

A feature that makes the Discover 7320 ideal for scanning text from manuals and books containing illustrations is the ability to automatically disregard graphics that appear within text as it scans. Though the Discover 7320 can read typeset fonts, consider the higher-end Kurzweil models that offer column recognition, landscape modes, and numerous foreign-language characters if you'll be scanning magazine articles, newspaper text, or other multicolumn documents.

The Discover 7320 can read a variety of electronically produced hard copy, including that of laser printers and facsimile machines. In our own tests, using laser-printed documents in a variety of typesizes and sizes, this scanner produced comparatively low error rates. Considering the amount of processing obviously occurring during a full-page scan, the Discover 7320 maintained impressive speed levels.

If your scanning needs are restricted to the fixed-space font families—ideally 10-point Courier—there are many scanners on the market capable of suiting your needs at reasonable prices. And if your scanning needs are sparse at most, investing in a scanner like the Discover 7320 Model 5 is a frivolity. But if your needs are for 50 to 100 pages per week of a wide variety of documents, this scanner may be worth every penny, to extract characters from printed material and convert to a format easily edited in your word processor.

THE K-5000 The heart of the Kurzweil K-5000 scanner is an interface/coprocessor card boasting its own 16-MHz 68020 processor coupled with a hefty 4MB of memory. Throw sheets of text into this scanner, start the software, and you are free to go about other tasks while the K-5000 performs its magic in the background. The only scans it can't perform without your attention are graphics scans, which are more system-intensive operations. These must be done in the foreground but the coprocessor board does its part in eliminating wait time: it took less than 5 minutes to scan the test photograph in 400-dpi gray-scale fashion.

The Kurzweil K-5000 behaves as though

it were designed with text scanning in mind. The front of the unit has been equipped with an obtuse-angled book edge to facilitate the scanning of bound material, and the scanner will work left-to-right to accommodate bound pages as well. The K-5000 refused to be daunted by large manuscripts. And its automatic document feeder provides unattended scanning of loose pages.

Kurzweil's proprietary ICR software employs not the more-traditional lookup-table method, but a 50,000-word lexicon. The software is also endowed with a modicum of artificial intelligence, which permits the system to recognize virtually any font—and in sizes ranging from 6 to 24 points. Furthermore, if you frequently scan documents containing uncommon or technical characters, the K-5000 allows you to predefine up to 10,000 words in your own lexicon.

Also included are lexicons for six other languages and output conversion routines to create files in your favorite word processor's format. There are many other options to Kurzweil's ICR software that go far toward making it the new standard in optical character recognition.

Graphically, the Kurzweil K-5000 shines. With 400-dpi resolution and a choice among binary, gray-scale, or half-tone scan modes, it provided PC Labs with some of the best-scanned images at non-where near the lengthy 23 minutes of its 730GS sibling. The K-5000's true brilliance appears when matched with printing hardware capable of handling its graphical capacity. Phototypesetters, high-resolution laser printers, and other big-dollar output devices really show off this scanner's acumen. All of which leads to this product's only true sore point: its price.

While at $15,950, the K-5000 is the most-expensive scanner in this review, for that price you're getting a complete scanning solution, with all of the technology and scanning expertise that a market leader like Xerox can muster. If you want only the best, like dancing on the edge of technology, and have $15,950 burning a hole in your pocket, then the Kurzweil K-5000 is the unquestionable choice that will meet all your scanning needs both now and in the future.—*Robert W. Kane and Tami Peterson*

HANDLING COLORS ON YOUR LAPTOP

Monochrome laptop screens can translate colors into different shades, but many of the resulting combinations are impossible to read. MONO.COM will make them legible.

Desktops haven't become dinosaurs yet, but in the evolutionary struggle, today's laptop computers have developed enough to match the performance of desktop computers in almost every respect. But while equaling their larger cousins in memory and speed, laptops still generally do have trouble displaying contrasting shades with sufficient clarity. This issue's utility, MONO.COM, will help you solve the problem of making your laptop's flat monochrome screen readable.

Flat color screens for laptops are still on the cutting edge of technology, but fortunately that does not limit laptops to act as applications suitable for a monochrome adapter. On the contrary, laptops can use a color graphics adapter to display color text and graphics applications on a monochrome report. The color attributes are simply translated into different shades of intensities of one color (blue or amber, for example). The monochrome graphics systems of desktop models work in much the same way.

The problem is that many existing laptop displays cannot display enough distinctively different intensity levels to accommodate the full range of possible colors. The result is that some color (shade) combinations become very difficult and even impossible to read.

If your laptop machine is giving you terminal eye strain because of the color combinations that are imposed by your favorite application, there is a way that you can trick the program into using the easier-to-read white-on-black attributes. You could just enter the DOS command

```
MODE BW80
```

before you start the application. Most color systems and monochrome graphics systems boot up in MODE CO80 (80-column color) by default. When BIOS switches to the black-and-white video mode with the

MODE BW80 command, it also stores the video-state information in a byte in a data area in low RAM. Considerate applications will inspect this information byte, known as CRT_MODE, and use black-and-white attributes instead of color if you're in a noncolor video mode.

Not all programs are so polite, however, and all graphics programs will surely ignore your MODE BW80 command. That's where this issue's utility, a TSR program called MONO.COM, comes in. MONO will not solve the color-contrast problem for graphics programs, but it *will* correct the illegibility of any text program that persists in displaying in unreadable color combinations.

The easiest way for you to get a copy of MONO.COM is to download it from PC MagNet, as explained in the accompanying sidebar "MONO by Modem." MONO.ASM, the assembly language source code, is printed here, as is MONO .BAS, a BASIC program that will automatically create MONO.COM when you run it once in BASIC. Both MONO.ASM and MONO.BAS can also be downloaded from PC MagNet.

MONO's syntax is simply

```
MONO [U]
```

Entering MONO alone installs and activates the program. MONO's resident portion takes up very little RAM (just over ½K), and the program works automatically in the background, converting color attributes either to white on black or black on white. MONO can later be uninstalled by reentering the command with the U param-

■ UTILITIES

eter. As always, be sure to uninstall TSRs in the reverse order of their installation. Also, remember to install *SideKick* (if you use it) last, or you won't be able to uninstall MONO. MONO is smart enough not to install itself more than once and it won't deinstall if doing so will make the system unstable.

By far the easiest way to install MONO is to make it a line in your AUTOEXEC .BAT file. However, if only specific offending applications require MONO's aid, then the separate batch file route is in order. For example, if a text program called

pressing the Alt-M key combination toggles MONO's monitoring status off and on. Since the program defaults to the on state when it installs, pressing Alt-M the first time disables MONO. Pressing it again reactivates the program. MONO doesn't tell you its current state except by the obvious change of any color attributes to black and white. Use the batch file method suggested above if you don't want to bother with hotkeys or don't want to remember MONO's state.

All TSRs present the potential problem of wanting to use two programs that have

an 80 by 25 display, a total of 2,000 attributes must be checked every ⅕ second. With that information comes the only drawback to using MONO, which is that the program takes up enough processor time to cause some performance degradation of the system.

The cost in speed varies with the system and the application, and I'll discuss the subject in more detail later in this article. In general, however, with word processing programs, where the machine spends most of its time waiting for you to type something, you will not notice much loss in speed. When it comes to a spreadsheet recalculation, however, MONO will make its presence known. MONO will not work at all with graphics programs, because adjusting bitmap graphics from the timer tick would put too much of a load on the system.

The "Customizing MONO" sidebar mentioned above in connection with changing the default hotkey also provides instructions for modifying how often MONO changes attributes. In addition, you can add snow checking for CGA adapters and even reverse the attribute-modifying algorithm.

Figure 1: The screenshot above shows how MONO.COM turns various color combinations into black-and-white so that they can be read on a laptop screen.

ANALYSIS is an unreadable blur on your laptop's screen, you would create a batch file (probably called A.BAT), consisting of the following lines:

```
MONO
ANALYSIS
MONO U
```

Then when you enter A at the DOS prompt, MONO will automatically install itself and work in the background while you run the ANALYSIS program. MONO will then deinstall itself when you exit ANALYSIS.

As an alternative, you can control MONO with a hotkey. After installation,

the same hotkey. The sidebar "Customizing MONO" shows you how to change MONO's default Alt-M hotkey to one you prefer.

HOW MONO WORKS MONO.COM monitors and changes the display attributes on every fourth timer tick. When attributes other than monochrome are detected, they are changed to monochrome. Any high-intensity or blinking attributes are retained in the process.

Timer ticks occur 18.2 times per second, which means that MONO grabs control and examines every attribute on the screen approximately every ⅕ second. For

USING THE TIMER TICK The design of MONO is quite simple. The program hooks two interrupts, interrupt 9 for the keyboard and interrupt 8, the timer tick. All that MONO's keyboard handler does is look for its hotkey combination. This, if found, toggles MONO's attribute-modifying-timer-tick interrupt handler on or off. MONO takes the timer tick so that it is guaranteed a periodic slice of processor time in which to change the video attributes to monochrome.

The attribute-adjusting algorithm is just as simple. Figure 1 shows how MONO examines and converts the display attributes. If any of the video buffer's background attribute bits are on, MONO converts the attribute to 70h (inverse video). Otherwise, the attribute is converted to 07h, which is normal white on black. The high bit of both nibbles of the attribute byte is not changed. These are the background blinking bit (bit 7) and the foreground intensity bit (bit 3). In the video buffer each character is followed by its corresponding attribute byte. For an 80 by 25 screen there are

CUSTOMIZING MONO

To keep MONO as simple as possible, I did not include code for handling options. It's possible, however, to modify several aspects of MONO's operation with DEBUG. Start by making a backup copy of MONO.COM and then enter

DEBUG MONO.COM

You are now ready to modify MONO .COM. If at any time you make a mistake, you can abort the editing process by entering Q. The last two commands that you enter after entering any modifications are

W
Q

for Write to disk and Quit DEBUG.

CHANGING THE HOTKEY The DE-BUG instructions to change MONO's active/inactive toggle hotkey are

E 194 xx

where xx is a scan code from the Key Scan Code table shown in Figure A, followed by

E 288 "a"

where a is the character represented by the scan code. For example, to change the default Alt-M hotkey to Alt-Z, the instructions would be

E 194 2C
E 288 "Z"

You can also change the hotkey from an Alt key combination to use any of the shifting key combinations shown in Figure B. For example, to use the Ctrl key instead of the default Alt key, you would enter the following instructions:

E 18E 4
E 283 "ctl"

Note, however, that (as in this example) the entry made at address 283 is limited to three letters within the quotes.

UPDATE FREQUENCY The frequency with which MONO checks and corrects attributes is controlled by a hexadecimal number that MONO adds to a counter byte on each timer tick. When the counter byte rolls over, MONO does an update. The default number added to this counter is 40h (64 decimal). Since the largest value a byte can hold is 255, the counter will roll over every 4th timer tick. In other words, the cumulative values in the counter (in decimal) will be 64, 128, 192, and 0 (40, 80, C0, and 0 in hex). The last zero value is 256 which is one more than the 255 maximum.

The 40h default equates to an update

approximately every ⅓ second. Decreasing the addition value will decrease the frequency rate, which will lessen the load that MONO puts on your system. If MONO doesn't update the display fast enough, increase the addition value, thus increasing the frequency. Remember that the addition number must be in hex. The appropriate DEBUG instruction is

E 16A xx

where xx is the hex addition value.

REVERSE THE ALGORITHM If MONO makes reading the display worse by turning the entire screen into inverse video, reverse the algorithm. After entering the next DEBUG instruction, MONO will convert any nonblack foregrounds to white on black. Only the attributes with black foregrounds will be converted to inverse video.

E 211 76 07

SNOW CHECKING Finally, if you have a CGA adapter and MONO makes your application look as if it's in the middle of a snowstorm, you can add snow checking with the instruction

E 213 EB 14

One note of caution, however: adding snow checking will severely slow the machine down.—**Michael J. Mefford**

Figure B: *The combination of shift keys needed to pop up the program corresponds to a unique SHIFT_MASK value in the MONO .ASM listing. You may substitute any of the values above for the default Alt key.*

SHIFT_MASK Value Table

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Alt									•	•	•	•	•	•	•	•
Ctrl					•	•	•	•					•	•	•	•
L-Shift			•	•			•	•			•	•			•	•
R-Shift		•		•		•		•		•		•		•		•
SHIFT-MASK Value	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

←Pressed

Keyboard Scan Codes for Alternative Hotkeys

Figure A: *If the hotkey combination used to activate the program is not to your liking, you can easily change the default to suit your preferences.*

■ UTILITIES

MONO's Attribute-Adjusting Loop

instructions			8088 cycles	80286 cycles
NEXT_ATTRIB:	MOV	AL, [DI]	13	5
	MOV	AH, BH	2	2
	TEST	AL, AH	3	2
	JNZ	ADD_ATTRIB	16	9
	MOV	AL, BL	2	2
ADD_ATTRIB:	AND	AL, NOT 77H	4	3
	OR	AL, AH	3	2
	STOSB		11	3
	INC	DI	2	2
	LOOP	NEXT_ATTRIB	17	10
		worst case total (JNZ is executed)	71	40
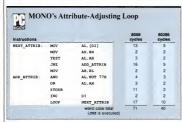
Figure 2: The 80286 can execute many of the same instructions as the 8088, in fewer clock cycles. The listing above shows MONO's processor-intensive loop, the execution of which takes most of the program's time. For an 80 by 25 display, the loop iterates 2,000 times.

What MONO Costs in CPU Time
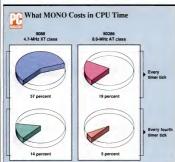
Figure 3: Machine performance is more than just a function of processor speed. The demand that the MONO.COM program places on an 8088-based 4.77-MHz machine is almost triple that of an 80286 8-MHz machine (14 percent versus 5 percent).

2,000 characters and 2,000 attributes, and MONO changes all 2,000 attributes on every fourth timer tick; that is, about every 1/5 (4/18.2) second. That's a lot of work, and it's an interesting problem to determine the actual demand MONO makes on a machine, namely, the percentage of CPU time the program takes away from an application's work time.

The amount of degradation varies widely among machines. To see why, let's consider two configurations in which MONO may be running: an 8088 4.77-MHz machine, the slowest processor found in the original PC-XT system; and an 80286-based 8-MHz machine, the ever-popular AT. Analysis of these cases will do more than shed light on the cost difference between the two. You'll also get an idea of some of the different factors that go into determining raw machine speed or, in the buzzword-heavy jargon of computer ads, MIPs (million instructions per second).

My analysis of MONO's performance begins by calculating the total number of clock cycles from one timer tick to the next. This number is then divided into the number of clock cycles MONO needs per timer tick to arrive at the percentage of the CPU cycles MONO consumes.

Let's look first at the total cycles per timer tick for the 4.77-MHz 8088 processor. The fundamental clock frequency for the timer tick is derived from a 14.31818-MHz crystal. This is divided by 3 to get down to the 4.77-MHz clock speed used by the processor in the original PCs. Since the original 8088s were capable of running at a full 5 MHz, why did IBM choose such a strange frequency? The answer is that the old video display adapters required a dot clock of 14.318 MHz, and IBM wanted to be clever and save the cost of another 50-cent crystal.

The 4.77 MHz used by the processor is again divided by 4 to produce the 1.19318-MHz input to the 8253 timer chip. The 8253 chip in turn has three outputs, one of which generates an interrupt for the system clock. This is the famous timer tick, interrupt 8. (Of the two other 8253 timer outputs, one is programmed to cause an interrupt to the DMA controller, which is responsible for RAM memory refresh every 15 microseconds. The other, when en-

■ UTILITIES

```
;----------------------------------------------------;
; MONO - TSR designed to make color applications readable on monochrome ;
; laptop computers by converting color attributes to monochrome.        ;
; System: MONO (U)                                                       ;
; PC Magazine * Michael J. Mefford                                       ;
;----------------------------------------------------;
```

MONO.ASM: The assembly language source code for MONO.COM. This utility makes otherwise-unreadable color combinations readable on a monochrome laptop screen. It can also be used with desktop screens.

(continues)

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■ UTILITIES

```
;----------------------------------------------------;
INITIALIZE    PROC   NEAR
              CLD                              ;All string operations forward.
              MOV    BX,OFFSET START           ;Point to start of code.
              NOT    BYTE PTR [BX]             ;Change a byte so no false match.
              XOR    DX,DX                     ;Start at segment zero.
              MOV    AX,CS                     ;Store our segment in AX.
NEXT_PARAG:   INC    DX                        ;Next paragraph.
              MOV    ES,DX
              CMP    DX,AX                     ;Is it our segment?
              JE     ANNOUNCE                  ;If yes, search is done.
              MOV    SI,BX                     ;Else, point to our signature
              MOV    DI,AX                     ; end offset of possible match.
              MOV    CX,16                     ;Check 16 bytes for match.
              REP    CMPSB
              JNE    NEXT_PARAG                ;If no match, keep looking.
;----------------------------------------------------;
ANNOUNCE:     MOV    DX,OFFSET SIGNATURE       ;Display our signature
              CALL   PRINT_STRING
              MOV    DX,OFFSET SYNTAX          ;And syntax.
              CALL   PRINT_STRING
;----------------------------------------------------;
PARSE:        MOV    SI,81H                    ;Point to command line again.
NEXT_PARSE:   LODSB                            ;Get a byte.
              CMP    AL,CR                     ;Is it CR?
              JE     INSTALL                   ;If yes, done here.
              AND    AL,5FH
              CMP    AL,"U"                    ;Is it "U" ?
              JNE    NEXT_PARSE                ;If no, next byte.
              MOV    DX,OFFSET NOT_INSTALLED   ;Else, see if installed.
              JE     MSG_EXIT                  ;If no, exit with error message.
              JMP    SHORT UNINSTALL           ;Else, uninstall.
;----------------------------------------------------;
INSTALL:      CALL   CK_INSTALLED              ;Check if already installed.
              JE     CK_AVAILABLE              ;If no, see if enough memory.
              XOR    AL,AL                     ;Else, done.
              JMP    SHORT EXIT                ;Exit with ERRORLEVEL = 0.
;----------------------------------------------------;
; This is the install procedure.
;----------------------------------------------------;
CK_AVAILABLE: MOV    BP,OFFSET SYNTAX          ;End of resident portion.
              ADD    BP,15                     ;Round up.
              MOV    BP,06;16;                 ;TSR @ PSP byte is segment?
              MOV    DX,OFFSET NOT_ENOUGH      ;If yes, exit without installing
              JA     MSG_EXIT                  ; with message.

              MOV    AX,3500H                  ;Else, get INT 8 vector.
              INT    21H
              MOV    OLD_INT_8[0],BX           ;Save old interrupt.
              MOV    OLD_INT_8[2],ES
              MOV    DX,OFFSET MONO_INT_8      ;Install new interrupt.
              MOV    AX,2508H
              INT    21H

              MOV    AX,3509H                  ;Get INT 9 vector.
              INT    21H
              MOV    OLD_INT_9[0],BX           ;Save old interrupt.
              MOV    OLD_INT_9[2],ES
              MOV    DX,OFFSET MONO_INT_9      ;Install new interrupt.
              MOV    AX,2509H
              INT    21H

              MOV    AX,DS:[2CH]               ;Get environment segment.
              MOV    ES,AX
              MOV    AH,49H                    ;Free up environment.
              INT    21H

              MOV    DX,OFFSET INSTALL_MSG     ;Display install message.
              MOV    DX,BP
              CALL   PRINT_STRING
              MOV    CL,4                      ;Retrieve resident request.
```

```
              SHR    DX,CL                     ;Convert to paragraphs.
              MOV    AX,3100H                  ;Return error code of zero.
              INT    21H                       ;Terminate but stay resident.
;----------------------------------------------------;
; Exit. Return ERRORLEVEL code 0 if successful, 1 if unsuccessful. ;
;----------------------------------------------------;
MSG_EXIT:     CALL   PRINT_STRING
ERROR_EXIT:   MOV    AL,1                      ;ERRORLEVEL = 1.
EXIT:         MOV    AH,4CH                    ;Terminate.
              INT    21H
;----------------------------------------------------;
; This subroutine uninstalls the resident MONO.COM. ;
;----------------------------------------------------;
UNINSTALL:    MOV    CX,ES                     ;Save segment in CX.
              MOV    AX,3508H                  ;Get interrupt 8.
              INT    21H
              CMP    BX,OFFSET MONO_INT_8      ;Was it been hooked by another?
              JNE    UNINSTALL_ERR             ;If yes, exit with error message.
              MOV    BX,ES                     ;Is the segment vector same?
              JNE    UNINSTALL_ERR             ;If no, exit with error message

              MOV    AX,3509H                  ;Get interrupt 9.
              INT    21H
              CMP    BX,OFFSET MONO_INT_9      ;Was it been hooked by another?
              JNE    UNINSTALL_ERR             ;If yes, exit with error message.
              MOV    BX,ES                     ;Is the segment vector same?
              JNE    UNINSTALL_ERR             ;If no, exit with error message

              MOV    AH,49H                    ;Return memory to system pool.
              INT    21H
              MOV    DX,OFFSET ALLOCATE_MSG    ;Display message if problem.
              JC     MSG_EXIT

              MOV    DX:ES:OLD_INT_8[0]        ;Restore old INT 8.
              MOV    DS:ES:OLD_INT_8[2]
              MOV    AX,2508H
              INT    21H
              MOV    DX:ES:OLD_INT_9[0]        ;Restore old INT 9.
              MOV    DS:ES:OLD_INT_9[2]
              MOV    AX,2509H
              INT    21H

              PUSH   CS
              POP    DS                        ;Point to our data.
              MOV    DX,OFFSET UNINSTALL_MSG   ;Display uninstall message
              CALL   PRINT_STRING
              OR     AL,AL                     ;Exit with ERRORLEVEL = 0.
              JMP    EXIT

UNINSTALL_ERR: MOV   AX,0                      ;If error, exit
              MOV    DX,OFFSET UNLOAD_MSG      ; with error message.
INITIALIZE    ENDP
;----------------------------------------------------;
; OUTPUT: ZR = 1 if not installed ZR = 0 if installed. ;
;----------------------------------------------------;
CK_INSTALLED: MOV    AX,ES
              MOV    BX,CS
              CMP    AX,BX                     ;Compare segments.
              RET
;----------------------------------------------------;
PRINT_STRING: MOV    AH,9
DOS_INT:      INT    21H                       ;Print string via DOS.
              RET
_TEXT         ENDS
              END    START
```

(MONO.ASM ends)

```basic
100 REM - BASIC PROGRAM TO CREATE MONO.COM
110 CLS:PRINT "Creating MONO.COM     ": OPEN "MONO.COM"  AS #1 LEN = 1
120 FIELD #1, 1 AS A$: CHECKSUM#=0
130 FOR I = 0 TO   50
140   LINESUM#=0: LOCATE 2,33: PRINT "Countdown: "   50 - I ;
150   FOR J = 1 TO  16: READ BYTE: BYTE = VAL("&H" + BYTE)
160     CHECKSUM# = CHECKSUM# + BYTE : LINESUM# = LINESUM# + BYTE
170     IF (BYTE < 256) THEN LSET A$=CHR$(BYTE): PUT #1
180   NEXT J
190   READ LINETOT$: LINETOT# = VAL("&H"+LINETOT$)
200   IF LINECHECK# > LINETOT# THEN GOTO 220
210   LOCATE 4,2: PRINT "Error in line #" ;  260 + 10 * I: GOTO 260
220 NEXT I
240 CLOSE: READ FILETOT$ : FILECHECK# = VAL(FILETOT$)
250 IF CHECKSUM# <> FILECHECK# THEN GOTO 260
260 PRINT: PRINT "MONO.COM    created successfully": SYSTEM
270 PRINT: PRINT "MONO.COM        is not valid": END
280 DATA E9, FF,  1, D, 2A, 2A, 2B,  D, A, 4D, 4F, 4E, 4F, 2E, 31, 2E,   425
290 DATA 30, 20, 24, 61, 29, 2E, 31, 39, 38, 39, 20, 5A, 69, 66, 66, 20,   3CE
300 DATA 43, 49, 60, 6D, 75, 6E, 69, 63, 61, 74, 65, 6F, 6E, 73, 2E, 43,   02E
310 DATA 6F, 2E, D, A, 55, 4E, 49, 4E, 53, 54, 41, 4C, 4C, 65, 20, 20,   548
...
```

(Remaining DATA lines continue)

MONO.BAS: *The program listed here will automatically create MONO.COM when you run it once in BASIC.*

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CIRCLE 286 ON READER SERVICE CARD

■ UTILITIES

abled, is used to pulse the speaker.) For the system clock, the timer chip is configured during the POST to produce an interrupt every time its 16-bit counter rolls over, by programming it with a divisor of 0. A divisor of 0 effectively creates a 64K divisor because 65,536 is one more than a word's 65,535 maximum. Dividing the 8253 input of 1,193,180 by 65,536 results in the 18.20651-Hz frequency that drives the timer tick interrupt 18.2 times a second.

For the 8088, then, the number of cycles between timer ticks is the CPU frequency (4.77 MHz) divided by the timer tick frequency (18.2 Hz), which gives us a little over 262,000 cycles per timer tick. For an 8-MHz AT class 80286 machine, dividing the 8-MHz CPU frequency by the 4.77-MHz timer tick yields about 439,000 cycles.

Parenthetically, although the 80286 has a faster crystal for the CPU, there is a second crystal on board that runs at 14.3 MHz. It's there just to drive the timer chip and any old display adapters, thus maintaining compatibility with previous equipment.

Just looking at the numbers you would think that an AT would be roughly twice as fast as an XT and that MONO would thus run twice as fast. But cycles don't tell the whole story.

MONO'S LOOP For the rest of the story we must turn to MONO's attribute-adjusting algorithm, the instructions for which are listed in Figure 2. An 80286 requires fewer clock cycles than an 8088 to execute many of the same instructions. Specifically, the 8088 requires 71 cycles to go through the Figure 2 loop once, while the 80286 can go through it in 40 cycles. Multiply the cycles per loop for each processor by the 2,000 iterations required to handle the attributes of 80 by 25 display, and you get a total of 142,000-plus for the 8088 and

an even 80,000 cycles for an 80286. To this must be added a handful of cycles for the overhead instructions of entering, setting up and executing MONO's interrupt handler.

A further 5 percent fudge factor must be added to the total looping cycles to account for DMA bus conflicts. The DMA takes care of refreshing the memory, without which RAM would soon lose its charge and thus its contents. Although DMA does its work without interrupting to ask the processor's permission, it does require the bus, the pathway to memory. The processor also needs access to the bus to fetch the instructions from RAM, however. Further, some instructions—in particular those that modify video memory—themselves must access memory. Since memory refresh is more important than processing instructions, DMA has priority. The processor must therefore insert wait-state cycles if the bus is not available.

How the competition stands

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I should add that my 5 percent fudge factor also covers wait states due to processor prefetch. Without going into great detail, it's enough to note that the processor can "prefetch" its next instruction at the same time it's executing its current instruction. This allows a smooth instruction flow, eliminating the need to stop constantly while the next instruction is fetched from memory. If, however, the current instruction jumps around the next instruction, prefetch goes for naught and processing of the jump-targeted instruction will have to wait until it is fetched. The JNZ and LOOP instructions in Figure 2 are examples of just such jumps. A processor cache (not to be confused with a disk cache) is a feature on new machines designed to eliminate the jump problem. Since most jumps are less than 128 bytes away, even a small processor cache will often have the jump-targeted instruction on hand, eliminating the wait cycles needed to get the next actual instruction.

We now have all the ingredients needed to calculate MONO's time demand. Simply divide the cycles MONO requires for its work by the total cycles available. The results are shown in Figure 3. For the 8088, MONO consumes 57 percent of the CPU's cycles; with the 80286 only 19 percent are lost. And, since I found that grabbing every fourth interrupt was enough to keep the screen updated, the actual numbers become 14 percent and 5 percent, respectively.

As you can see, calculating processor cycles can get complicated. Even the numbers presented here are not meant to be exact. Indeed different configurations—processor type, processor cache, and clock speed, for example—will produce widely different results. But the example does illustrate that looking at processor clock speed alone does not return the full answer.

NO ALTERNATIVE A more efficient solution to the attribute-conversion problem might seem to be to hook interrupt 10h, the BIOS video service. This procedure would intercept screen writes only as they occurred. The problem, however, is that in an effort to achieve snappier displays, most applications skip the BIOS and write directly to the video buffer. Therefore, in fact, there is no real alternative to the procedure MONO offers.

Bear in mind that although it was conceived with the laptop in mind, MONO is no less suited to monochrome graphics desktop systems that exhibit the same contrast problems. And while in some configurations the performance cost may be heavy, this solution sure beats straining your eyes or not being able to read the screen at all.

Michael J. Mefford is a contributing editor of PC Magazine.

■ ENVIRONMENTS ■ CHARLES PETZOLD

PARING DOWN THE STANDARD WINDOW

Presentation Manager programs don't all have to look and act alike. TIMELINE shows how to take a minimalist approach in replacing what would require a TSR in DOS.

Back in the days of DOS, there were a lot of people who used RAM-resident programs, also known at the time as TSRs. One popular type of TSR displayed the date and time in a corner of the screen. Such TSRs intercepted interrupt 8 to update the display every second.

Let's create a similar program for today's OS/2 Presentation Manager. I don't mean that we're going to write a TSR, of course! In a windowing environment, most DOS TSRs can be rewritten as normal Presentation Manager programs. That's what Borland did, for example, when rewriting *SideKick* for the PM.

Figure 1 shows the video display of the TIMELINE program we'll create to run under the Presentation Manager. TIMELINE displays the time and date in a tiny window located at the bottom-left corner of the screen. The program is small enough to fit in the space below the icon area.

The format of the date and time in this window may look a little unfamiliar. In fact, however, it is a standard format often used in Unix programs and is supported by functions included with most C compilers. I used this format just to simplify the program a bit.

But you'll also note that the window itself looks a little strange. It doesn't *look* like a Presentation Manager program. After all, PM programs have title bars and sizing borders and system menus and minimize/maximize buttons. TIMELINE has none of those. It's just a little box surrounded by a thin black border.

TIMELINE is indeed a Presentation

Manager program, but one that has been pared down very nearly to the bare essentials. As you'll see, you don't do this by adding anything to the program (that would imply some sort of trickery), but by removing things from the program.

FREEDOM OF CHOICE One goal of the Presentation Manager is to establish a consistent user interface for applications. All menus in Presentation Manager function the same way, for example, and most PM programs have a title bar, which identifies the program and lets you move the window around the screen with the mouse. This consistent user interface makes it easy to learn Presentation Manager programs very quickly.

Some people are suspicious of this idea, however, fearing that it means that all PM programs will look and act the same. Actually, the consistency of the user interface really affects only its most mundane as-

■ One goal of the Presentation Manager is to establish a consistent user interface for applications to make PM programs easy to learn.

pects, such as menus and scrollbars. Programmers have lots of freedom within the client window to tailor the user interface to the particular application.

And it's certainly not true that all Presentation Manager programs must look and act the same. You can make a PM program look and act any way you like. If programmers want to define unique menu interfaces for PM programs, they can ignore the built-in menu logic and write their own menu logic. If programmers don't wish their programs to be sizable, the windows can be made a fixed size (as TIMELINE is), even to the point of encompassing the whole screen.

I've even read columns by other technical journalists who seem to want to use the GPI (the Graphics Programming Interface included in the Presentation Manager) without the Presentation Manager user interface. Such a desire seems strange to me but it can certainly be done, and rather easily at that. The PM user interface is an option for an application, not a requirement.

STANDARD WINDOWS Much of what is standardized in the Presentation Manager user interface involves the concept of the *standard window*.

Shortly after beginning execution, PM programs usually call the WinCreateStdWindow function to create a standard window for the application. The standard window is actually a collection of windows. For example, the title bar, system menu, and minimize/maximize buttons are all separate windows that are parts of the standard window. Each of these windows has a

■ ENVIRONMENTS
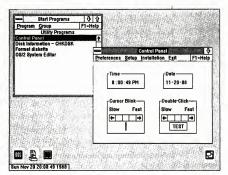
Figure 1: *The TIMELINE program displays the current date and time in a tiny window located at the bottom-left corner of the screen.*

window procedure (located in the PMWIN.DLL dynamic link library) that processes messages to it and displays the output.

WinCreateStdWindow always creates at least one window, which is called the "frame" window. All the other windows created by the function are "children" of the frame window and are positioned in standard places relative to it. In effect, the frame window holds all the other windows together.

More often than not, WinCreateStdWindow also creates a "client" window. This is where the application itself displays its output. The window procedure for the client window is usually located in the program itself, though it can be located in a dynamic link library.

You can specify certain other characteristics of the standard window in the WinCreateStdWindow function. For example, the frame window can display a border. This is normally a thick, "sizing" border that allows the user to change the window size. However, you can specify a thin border for the frame window, which is what the TIMELINE program does. This type of border does not allow the window to be changed in size by the user.

You designate the windows you want and some of their characteristics by the third WinCreateStdWindow parameter. This parameter is a pointer to a ULONG (unsigned long integer) that contains a series of bit flags (called "frame creation flags"). The PMWIN.H header file contains identifiers for all the frame creation flags, which are shown in Figure 2.

When defining the ULONG that you use as the third parameter in WinCreateStdWindow, you can combine these identifiers with the C bitwise OR operator (|). With two exceptions, each identifier sets one bit in the ULONG. The exceptions are FCF_MINMAX (which is a combination of FCF_MINBUTTON and FCF_MAXBUTTON, the minimize/maximize buttons in the upper-right corner of the window) and FCF_STANDARD, which combines the most-common frame creation flags.

Whether WinCreateStdWindow creates a client window or not is governed by the fourth parameter to the function. This is a pointer to a character string containing the name of the window class for the client window. If this parameter is set to NULL,

WinCreateStdWindow does not create a client window.

If you want to create a standard window with all the standard accessories, you can define a ULONG variable (named fl-FrameFlags, for example) and initialize it like this:

```
static ULONG flFrameFlags =
    FCF_STANDARD ;
```

You would then pass a pointer to flFrame-Flags as the third parameter of WinCreate-StdWindow.

If you want all the standard accessories except an accelerator table (a table that contains keystrokes that generally duplicate common menu commands), you can remove the FCF_ACCELTABLE flag from FCF_STANDARD thus:

```
static ULONG flFrameFlags =
    FCF_STANDARD & ~FCF_ACCELTABLE ;
```

You can also dispense with FCF_STANDARD and explicitly combine the identifiers you want. For example, some simple Presentation Manager programs don't have menus, accelerator tables, or icons. Here's the definition of flFrameFlags for such a window:

```
static ULONG flFrameFlags =
    FCF_title bar      FCF_SYSMENU   |
    FCF_SIZEBORDER     FCF_MINMAX    |
    FCF_SHELLPOSITION  FCF_TASKLIST ;
```

This makes it easy to customize the appearance and functionality of the standard window. If you don't want a title bar for your program (or if you want to draw your own title bar), you simply don't use the FCF_title bar flag when initializing fl-FrameFlags.

THE TIMELINE WINDOW Now let's look at TIMELINE. The three files necessary for creating the TIMELINE.EXE program are shown in Figures 3, 4, and 5. If you have the Microsoft C compiler and OS/2 1.1 Programmer's Toolkit set up on your hard disk, you can create TIMELINE .EXE by running

```
MAKE TIMELINE
```

Notice that flFrameFlags is initialized in the main function with only two frame creation flags: FCF_BORDER and FCF_TASKLIST. WinCreateStdWindow will only create two windows, a frame

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window and a client window. The frame window contains a thin border around its perimeter. The client window is slightly smaller than the frame window so that the border is visible. (The FCF_BORDER flag is not necessary for TIMELINE, but it gives the window a better appearance.)

Of course, the absence of the standard accessories reduces the functionality of TIMELINE a bit. The lack of a title bar means that you can't move the window to another part of the screen. However, the program could include its own moving logic, though TIMELINE doesn't. Without a sizing border, TIMELINE cannot be resized. Without the minimize and maximize buttons, the program can't be maximized to fill the whole screen or minimized enough to be displayed as an icon.

Without a system menu, there would seem to be no way to terminate the program. Note, however, that the FCF_TASKLIST flag used in flFrame-Flags puts the program on the PM Task Manager list. Hence, you can terminate TIMELINE by highlighting the program in the Task Manager and selecting the Close option on the Task menu. The Task Manager terminates the program by posting a WM_QUIT message to the program's message queue. This message causes WinGetMsg to return FALSE

```
#--------------------
# TIMELINE make file
#--------------------

timeline.obj : timeline.c
    cl -c -G2sw -W3 timeline.c

timeline.exe : timeline.obj timeline.def
    link timeline, /align:16, NUL, os2, timeline
```

Figure 3: *The TIMELINE Make file automates the creation of TIMELINE.EXE.*

when the message is retrieved from the queue. The program drops out of its message loop, destroys the window and message queue, and terminates.

THE WINDOW MESSAGES TIMELINE registers a window class for the client window by calling WinRegisterClass in main. The class name is TimeLine, and the window procedure is the function ClientWndProc. This class name is supplied as the fourth parameter of WinCreateStdWindow. The presence of that parameter causes the function to create a client window.

ClientWndProc processes four messages to the window: WM_CREATE, WM_TIMER, WM_PAINT, and WM_DESTROY. All other messages received by the window procedure are passed on to WinDefWindowProc for default processing.

A window procedure receives a WM_CREATE message when the window is first created and before the window is displayed. This message is generated during the WinCreateStdWindow call and is the first message the window procedure receives. If a window procedure needs to do some initialization, this is an excellent opportunity. During the WM_CREATE message, ClientWndProc first calls a function in TIMELINE.C called SizeWindow that I'll discuss shortly.

To keep the window updated with the current time, TIMELINE needs to be notified every second. It does this using a Presentation Manager timer. ClientWndProc starts this timer during the WM_CREATE message:

```
WinStartTimer (hab, hwnd, ID_TIMER, 1000) ;
```

The WinStartTimer call causes WM_TIMER messages to be periodically

Frame Creation Flags

Identifier	Value	Included in FCF_STANDARD
FCF_TITLEBAR	0x00001L	●
FCF_SYSMENU	0x00002L	●
FCF_MENU	0x00004L	●
FCF_SIZEBORDER	0x00008L	●
FCF_MINBUTTON	0x00010L	●
FCF_MAXBUTTON	0x00020L	●
FCF_MINMAX	0x00030L	●
FCF_VERTSCROLL	0x00040L	○
FCF_HORZSCROLL	0x00080L	○
FCF_DLGBORDER	0x00100L	○
FCF_BORDER	0x00200L	○
FCF_SHELLPOSITION	0x00400L	●
FCF_TASKLIST	0x00800L	●
FCF_NOBYTEALIGN	0x01000L	○
FCF_NOMOVEWITHOWNER	0x02000L	○
FCF_ICON	0x04000L	●
FCF_ACCELTABLE	0x08000L	●
FCF_SYSMODAL	0x10000L	○
FCF_SCREENALIGN	0x20000L	○
FCF_MOUSEALIGN	0x40000L	○
FCF_STANDARD	0x0CC3FL	○

● — Yes ○ — No

Figure 2: *These frame creation flags let you specify characteristics of the frame window as the third parameter in the WinCreateStdWindow function.*

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posted to the window. The first and second parameters are handles—the anchor block handle returned from the WinInitialize call in main, and the handle to the client window, which is passed as a parameter to ClientWndProc.

The third parameter to WinStartTimer is a timer ID number, which is defined (near the top of TIMELINE.C) as 1. Each timer a program starts must have a unique timer ID. The last parameter is an elapsed time, in milliseconds. Thus, a WM_TIMER message will be posted to the client window every 1,000 milliseconds, or once per second. ClientWndProc uses the WM_TIMER message to update the time, as I'll describe shortly.

The WM_DESTROY message is sent to the window procedure during the Win-

DestroyWindow call in main. WM_DESTROY is usually the last message the window procedure receives, and most programs take this opportunity to clean up. During the WM_DESTROY message, ClientWndProc stops the timer:

```
WinStopTimer (hab, hwnd) ;
```

In the case of TIMELINE, that's all the cleaning up that needs to be done.

SIZING THE WINDOW Looking at Figure 2, you'll notice that FCF_SHELL-POSITION is one of the frame creation flags included in FCF_STANDARD. This flag indicates that the Presentation Manager shell should give the window a default size and position on the screen when the window is first displayed.

However, some windows (including TIMELINE's) require a nondefault size and position. In fact, all the Presentation Manager programs included in OS/2 1.1—the Task Manager, Start Programs, File System, Control Panel, and Spooler Queue Manager—use nondefault window sizes. Such programs should not use FCF_SHELLPOSITION when creating the standard window, and must instead call WinSetWindowPos to give the frame window an initial position and size.

The SizeWindow function in TIMELINE.C (Figure 4) is responsible for this. SizeWindow culminates in a call to WinSetWindowPos, but before that there's some preliminary work to be done.

SizeWindow must first determine how large a client window is needed to display

```
/*-----------------------------------------------------------------
    TIMELINE.C -- Time and Date Display for OS/2 Presentation Manager
                    (c) 1989, Ziff Communications Co.
                PC Magazine ■ Charles Petzold, November 1988
  -----------------------------------------------------------------*/

#define INCL_WIN
#define INCL_GPI
#include <os2.h>
#include <string.h>
#include <time.h>

#define ID_TIMER 1

MRESULT EXPENTRY ClientWndProc (HWND, USHORT, MPARAM, MPARAM);

HAB  hab ;

int main (void)
{
    static CHAR  szClientClass[] = "TimeLine" ;
    static ULONG flFrameFlags = FCF_BORDER | FCF_TASKLIST ;
    HMQ          hmq ;
    HWND         hwndFrame, hwndClient ;
    QMSG         qmsg ;

    hab = WinInitialize (0) ;
    hmq = WinCreateMsgQueue (hab, 0) ;

    WinRegisterClass (hab, szClientClass, ClientWndProc, 0L, 0) ;

    hwndFrame = WinCreateStdWindow (HWND_DESKTOP, WS_VISIBLE,
                                    &flFrameFlags, szClientClass, NULL,
                                    0L, NULL, 0, &hwndClient) ;

    while (WinGetMsg (hab, &qmsg, NULL, 0, 0))
        WinDispatchMsg (hab, &qmsg) ;

    WinDestroyWindow (hwndFrame) ;
    WinDestroyMsgQueue (hmq) ;
    WinTerminate (hab) ;
    return 0 ;
}

VOID SizeWindow (HWND hwnd)
{
    static CHAR szDummyTime[] = " Wed May 00 00:00:00 0000 " ;
    HPS         hps ;
    HWND        hwndFrame ;
    POINTL      aptl[TXTBOX_COUNT] ;
    RECTL       rcl ;

                    // Find width and height of text string

    hps = WinGetPS (hwnd) ;
    GpiQueryTextBox (hps, (LONG) strlen (szDummyTime), szDummyTime,
                     TXTBOX_COUNT, aptl) ;
    WinReleasePS (hps) ;

                    // Set up rectangle structure based on text dimensions

    rcl.xLeft   = 0 ;
    rcl.yBottom = 0 ;
    rcl.xRight  = aptl[TXTBOX_BOTTOMRIGHT].x - aptl[TXTBOX_BOTTOMLEFT].x ;
    rcl.yTop    = aptl[TXTBOX_TOPLEFT].y   - aptl[TXTBOX_BOTTOMLEFT].y ;

                    // Set frame window position and size
```

```
    hwndFrame = WinQueryWindow (hwnd, QW_PARENT, FALSE) ;
    WinCalcFrameRect (hwndFrame, &rcl, FALSE) ;
    WinSetWindowPos (hwndFrame, NULL,
                     (SHORT) rcl.xLeft,   (SHORT) rcl.yBottom,
                     (SHORT) rcl.xRight,  (SHORT) rcl.yTop,
                     SWP_MOVE | SWP_SIZE) ;
}

VOID UpdateTime (HWND hwnd, HPS hps)
{
    CHAR   szTime ;
    CHAR   szFormattedTime[40] ;
    RECTL  rcl ;
    time_t lTime ;

                    // Get ASCII time and date string and format it

    time (&lTime) ;
    szTime = ctime (&lTime) ;
    strcpy (szFormattedTime, "  ") ;
    szFormattedTime[strlen (szFormattedTime) - 1] = '\0' ;
    strcat (szFormattedTime, "  ") ;

                    // Display string in client window

    WinQueryWindowRect (hwnd, &rcl) ;
    GpiSetBackMix (hps, BM_OVERPAINT) ;
    WinDrawText (hps, -1, szFormattedTime, &rcl,
                 CLR_NEUTRAL, CLR_BACKGROUND, DT_CENTER | DT_VCENTER) ;
}

MRESULT EXPENTRY ClientWndProc (HWND hwnd, USHORT msg, MPARAM mp1, MPARAM mp2)
{
    HPS hps;

    switch (msg)
    {
        case WM_CREATE:
            SizeWindow (hwnd) ;
            WinStartTimer (hab, hwnd, ID_TIMER, 1000) ;
            return 0 ;

        case WM_TIMER:
            hps = WinGetPS (hwnd) ;
            UpdateTime (hwnd, hps) ;
            WinReleasePS (hps) ;
            return 0 ;

        case WM_PAINT:
            hps = WinBeginPaint (hwnd, NULL, NULL) ;
            UpdateTime (hwnd, hps) ;
            WinEndPaint (hps) ;
            return 0 ;

        case WM_DESTROY:
            WinStopTimer (hab, hwnd, ID_TIMER) ;
            return 0 ;
    }
    return WinDefWindowProc (hwnd, msg, mp1, mp2) ;
}
```

Figure 4: *The TIMELINE.C file contains all the source code necessary to create the TIMELINE program.*

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```
|------------------------------------
| ; TIMELINE.DEF module definition file
|------------------------------------

NAME           TIMELINE WINDOWAPI

DESCRIPTION    'Time and Date Display (c) 1989, Ziff Communications Co.'
PROTMODE
HEAPSIZE       1024
STACKSIZE      8192
EXPORTS        ClientWndProc
```

Figure 5: *The TIMELINE.DEF module definition file contains information that LINK uses when constructing TIMELINE.EXE.*

the time and date. Because the size of this window must be specified in units of pixels, it is dependent on the resolution of the video display. For this reason, the required size of the window is not hard-coded in the program.

Instead, the SizeWindow function calls GpiQueryTextBox to determine the pixel dimensions of the text string szDummyTime. This text string contains a date and time in the format returned by the C ctime function and contains a one-space margin on the left and right. I use Wed and May as the day of the week and month in this string because the default Presentation Manager font is a proportionally spaced Helvetica font, and W and M are wide letters. Thus, the text string dimensions obtained from GpiQueryTextBox are the maximum for any possible date.

SizeWindow then assigns the fields of a RECTL (rectangle) structure named rcl to specify the position of the client window in pixel coordinates relative to the lower-left corner of the screen. Using 0 for the xLeft and yBottom fields of this structure puts the client window at the lower-left corner of the screen. The xRight and yTop fields are set to the coordinates of the right and top side of the window. Because the lower-left corner of the client window is positioned at the point (0,0), these coordinates specify the width and height of the text string.

However, what we actually need for the WinSetWindowPos function is the position and size of the frame window, not of the client window. The frame window must be a little larger than the client window because it includes a thin border. The WinCalcFrameRect function is specifically designed for this purpose—it converts the fields of a RECTL structure, specifying the client window position and size in

terms of coordinates for the frame window. As an alternative to the procedure I used, you can convert from the frame window rectangle to the client window rectangle by setting the last parameter of WinCalcFrameRect to TRUE.

The WinSetWindowPos function requires four parameters to specify the position and size of the window. These are easily derived from the fields of the RECTL structure. When the window is displayed, some time after the WM_CREATE message, it will be positioned and sized based on these values.

UPDATING THE TIME We've seen how TIMELINE creates the standard window and gives it a nondefault size and position, so the final task is to display the time and date in the client window.

ClientWndProc must update the client window in response to two messages: WM_PAINT and WM_TIMER. The WM_TIMER message is received every second, based on the initial call to WinStartTimer. The WM_PAINT message occurs when part of the client window is invalid and must be updated. For both these messages, ClientWndProc calls the UpdateTime function in TIMELINE.C.

UpdateTime begins by calling the C time function. This function returns the number of seconds since January 1, 1970. The ctime function converts this into a 26-byte ASCII string and returns a pointer to the string. This is stored in szTime.

TIMELINE can't use this string directly. For one thing, it contains a line feed character, a remnant of the ancient Teletype. So, UpdateTime copies the szTime string into szFormattedTime, removes the line feed character, and pads the string with three blanks on the left and right. (The reason for the blanks will soon be evident.)

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UpdateTime then calls WinQueryWindowRect to obtain the dimensions of the client window and WinDrawText to display the formatted text string centered within this rectangle.

You'll notice that there's a difference in the ClientWndProc logic for the WM_PAINT and WM_TIMER messages. The first difference is that the WM_PAINT processing calls WinBeginPaint and WinEndPaint to obtain and release a handle to the presentation space. The WM_TIMER processing uses WinGetPS and WinReleasePS instead. This is normal: the WinBeginPaint and WinEndPaint functions are for use only during a WM_PAINT message. Any program that wishes to draw on its client window during

> ■ WinBeginPaint and WinEndPaint are for use only during a WM_PAINT message.

messages other than WM_PAINT uses WinGetPS and WinReleasePS.

The WM_PAINT logic also includes a call to GpiErasePS. This causes the invalid area of the window to be erased before the text string is displayed. If the WM_TIMER logic were to include this call, the window would flicker as it is erased and then redrawn every second.

Successive WM_TIMER processing simply displays the new time and date on top of the old one, without erasing. This also presents a potential problem. By default, when GPI displays text, it draws only the characters and not the background of the character box. Thus, each new time would be displayed on top of the previous time, which would eventually result in solid black blocks where the characters should be! To prevent this, UpdateTime calls GpiSetBackMix with a BM_OVERPAINT parameter. This causes the background of the character box to be drawn also, thus effectively erasing the previous characters without flicker.

Because the PM default font is propor-

tionally spaced, the text string becomes smaller as the day changes from Wednesday to Thursday. To erase the previous character string fully, the displayed string is padded with three blanks on each end.

AUTOMATIC STARTUP In the old DOS days, when you wanted to run a TSR every time you booted up, the solution was simple. You would just put it in your AUTOEXEC.BAT file.

For the newer OS/2 Presentation Manager programs, the method is similar: Put it in your STARTUP.CMD file. If a STARTUP.CMD file is present in the root directory when you boot up OS/2 1.1, the Presentation Manager will open a text window in the PM session and run the CMD.EXE command processor, which will then execute the commands in STARTUP.CMD. Although IBM's installation program for OS/2 1.1 does not create a STARTUP.CMD file for you, it is an easy enough task to set one up for yourself.

However, what you *don't* want to do is simply run the program in STARTUP.CMD like this:

    [path]TIMELINE

(The [*path*] is the drive and directory where TIMELINE.EXE is stored.) If you do it this way, the CMD.EXE prompt will not reappear until you terminate the TIMELINE program!

What you should do instead is use the OS/2 START command to start a new session for the program, and type in the following:

    START [path]TIMELINE

If you use START with a PM program, the program will be run in the Presentation Manager session and the CMD.EXE prompt will reappear. If you'd prefer that the CMD.EXE window not remain active after TIMELINE is run, you can terminate CMD.EXE and close the window by using the command

    EXIT

in STARTUP.CMD.

By default, the program will be listed in the Task Manager with the filename "TIMELINE.EXE." If you prefer a different title, you can specify one in quotation marks thus:

    START "Time Line Display" [path]TIMELINE

Also bear in mind that you can set a PATH environment using a SET statement in CONFIG.SYS. This PATH will be used in every program started up under OS/2. If you keep TIMELINE.EXE in one of the directories listed in the PATH string, you don't need to specify the path in the START command.

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Tear out and hole-punch the command summary on this page and add it to your DOS manual.

MONO Command

Michael J. Mefford — March 28, 1989 (Utilities)

Purpose:	Makes the display of color applications legible on laptop computers and other monochrome screens that have limited intensity ranges, by translating the color attributes into black-and-white.
Format:	MONO [U]
Remarks:	MONO is a memory-resident utility that is normally loaded as part of an AUTOEXEC.BAT file. If no other TSR programs are installed after it, MONO can be deinstalled by reentering the command with the U parameter added.
	Once installed, MONO automatically converts color attributes into black-and-white, updating the screen approximately five times each second. Since a typical 80 by 25 display contains 2,000 attribute bytes, some loss in speed must be anticipated, though the amount of degradation will vary with the type and clock speed of the system microprocessor. For applications that do not require MONO, its active state can be toggled off and on with alternate presses of Alt-M, the default hotkey.
	Instructions for changing the default hotkey and the screen update frequency (should the entire screen appear in reverse video after color translation) and eliminating "snow" produced by CGA adapters are contained in a sidebar to the published article.
Note:	MONO is not intended to work with graphics programs.
	Available for downloading from PC MagNet (see the "MONO by Modem" sidebar), MONO.COM is already compiled and ready to run. As an alternative, MONO.COM can be created from either of two program files that are both printed in the article and are available for downloading from PC MagNet. MONO.BAS will automatically create MONO.COM when run once in BASIC. To create MONO.COM from the MONO.ASM source code requires use of a macro assembler (IBM or Microsoft, Version 2 or later) and the following commands:

```
MASM MONO;
LINK MONO;
EXE2BIN MONO MONO.COM;
```

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■ **POWER PROGRAMMING** ■ RAY DUNCAN

MANAGING RANDOM ACCESS FILES

Random access files come in both indexed and nonindexed flavors. Here's a taste of the nonindexed variety, replete with programming examples in C and assembly language.

M ost programs that manage data—other than simple ASCII text—use random access files rather than the sequential files we examined in the last column. A random access file is structured, organized, or indexed in such a way that you can read or write a specific record in it without inspecting all of the records that physically precede it in the file. *dBASE* data files, with which almost every reader is familiar, are typical of random access files, but there are also many less obvious examples. A *Microsoft Word* document file, for instance, is a random access file because it lets you "jump" directly to a particular document page without having to scroll through from the beginning.

The management of random access files—creating, updating, indexing, sorting, searching, and merging—touches on many key programming issues. Some of these topics have been studied and discussed intensely from the earliest days of computing. A peek into the textbooks of such learned professors as Knuth, Sedgewick, and Wirth will turn up an algorithm for every conceivable need—accompanied, quite likely, by a careful cost-benefit analysis of its performance. I can't hope even to survey all that accumulated wisdom in this column, but I will try to demonstrate some of the trade-offs and provide you with a few useful routines in the bargain.

TYPES OF RANDOM ACCESS FILES

Random access files can be divided into two broad types: indexed, and nonin-

dexed. In indexed files, the records are stored in a main file, within which they may be either ordered or unordered. The index, which is usually stored in another file altogether, consists of a copy, from each record, of the field that is to be used for search purposes (called the record key), together with the record's number or relative position in the main file. When a program needs to find a record, it first locates the key within the index file, extracts the record pointer, and then fetches the record of interest from the main file. I'll defer further discussion of indexed files to the next column.

In a nonindexed random access file, the records are usually all the same size, and each record's position in the file is determined by the value contained in its key field. When you want to find a particular record in the file, you can use one of two basic strategies: a sequential search or a binary search.

> ■ When you want to find a particular record in a nonindexed random access file, you can use either a sequential search or a binary search.

THE BRUTE FORCE APPROACH
Using the sequential strategy, we simply start at the beginning of the file and read records one after another until we (1) find the record we want, (2) find a record whose key tells us that the record we desire does not exist, or (3) hit the end of file. If our file contains *n* records, we will inspect, on average, *n*/2 records to find a particular record or learn that it isn't present.

The brute-force technique isn't really so bad for quick-and-dirty applications that use relatively small files. But its performance on large files is dreadful, and it can even be shockingly bad on small files when the key values and search targets are not evenly distributed. Of course, you could cheat a little and write your program so it adapts to the data. Suppose, for example, the program notices that over time the average number of records inspected is considerably more than half the number of records in the file. It could alter its behavior so it starts with the last record in the file and reads toward the front of the file instead.

BINARY SEARCHING
A superior search strategy for dealing with a nonindexed but ordered file of fixed-length records is the "binary search." This is one of the so-called "divide-and-conquer" algorithms. To begin a binary search you find the size of the file, calculate the number of records it contains, then inspect the middle record. If that record is a match, you're done (and lucky). Otherwise, depending on whether the middle record's key was "before" or "after" the key of the record

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you want, you next examine the middle record of the first or last half of the file. You continue with successive bisections of the file until you've either found the record you want or established that it isn't there.

The binary search technique is illustrated in Figure 1. Like the Quicksort algorithm we discussed in previous columns, this algorithm is particularly well suited to languages that support recursion gracefully—languages such as C or Forth. Although the algorithm is quite simple, a binary search is surprisingly efficient. If a file contains n records, a maximum of $\log^2(n)+1$ and an average of $\log^2(n)-1$ comparisons are required to find a particular record. As you can see by the closeness of those two numbers, the binary search technique is also relatively insensitive to nonrandom distributions of keys in the data file or the search target.

NONINDEXED FILE DRAWBACKS

Knowing that binary searches are relatively quick and that nonindexed files are simpler to implement and maintain than indexed files, you might wonder why they

aren't used more often. The main reason is that updating nonindexed files is expensive, both in time and disk space.

To add a record to a nonindexed file safely, you must copy the old file to a new file, inserting the new record at the appropriate point, and then delete the old file (or let it hang around as a backup). In other words, before getting started, you need to have enough disk space to hold both the resulting new file and the old file. Further, to create the updated file, you must read and write every single record in the original file. That's pretty discouraging, though at least the original file remains unaltered if the update doesn't complete successfully.

A less secure approach to adding a record is to update the original file in place. The program first moves all of the existing records after the insertion point down one position, then writes the new record into the slot thus opened up. In this scenario, you only need enough free disk space before you get started to hold the new record. However, if the program updating the disk crashes or someone turns off the machine before the program completes, the file will

most likely be left with a spurious duplicate of one of the old records, and the new record will be lost.

Deleting a record from a nonindexed file is also slow and messy. You can copy the old file to a new file, removing the record in the process, or you can delete the record in place: either by moving all subsequent records forward one position ("closing up" the file) or by marking it as deleted with a special reserved key value. This latter approach (which *dBASE* uses) involves "packing" the file at some future point. The packing process physically removes the deleted records and thus reclaims the wasted space they occupy before they start to affect search performance.

Last but not least, altering the key field of an existing record incurs both the problems of adding a record in one place and deleting it in another. Of course, most record alterations don't involve the key field—the key tends to be a stable piece of data, such as someone's name or account number—and thus they don't necessitate a record movement.

How a Binary Search Works

First Search

Active search range

Second Search

Active search range

Third Search

Active search range

The middle record is examined. Since key XX comes after key NN, the second half of the file will be searched next.

Again, the middle record is examined. Key XX comes after key TT, so again the latter half of the search range will be inspected.

The middle record is examined and found to be the desired record.

Figure 1: *This example illustrates a simple binary search. The file contains 15 records, whose keys are two-character sequences. A successful search for the key XX requires the inspection of 3 records.*

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```
/*
MAKENIF.C creates ordered non-indexed random
           access file for use by MAKENIF.C
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The user is prompted to enter five more to one hundred
ASCII strings. These strings are then sorted and used
to hold records in the file TESTFILE.DAT.

Each record in TESTFILE.DAT is RSIZE bytes long. Byte
0 to (NSIZE-1) of the record are the ASCII key for the searches
by MAKENIF.C.  Bytes RSIZE to (RSIZE-1) of the record
are initialized to zero and are not used.
*/

#include <stdio.h>
#include <string.h>
#include <stdlib.h>
#include <fcntl.h>
#include <sys\types.h>
#include <sys\stat.h>
#include <io.h>

#define INIEM  80          /* max entry length */
#define N_ITEMS 100         /* max number of strings */
#define NSIZE   64          /* fixed record size */
#define RSIZE   64          /* max key length */

static char items[N_ITEMS + NSIZE];  /* entered keys stored here */

main(int argc, char *argv[])
{
    int i, j;              /* some scratch variables */
    int fh;                /* handle for output file */
    char rec[RSIZE];       /* scratch record buffer */

    i = 0;                 /* initialize string count */

    while(i < N_ITEMS)     /* enforce maximum entries */

    printf("%d\d", i+1);   /* prompt user for next string */
    gets(&items[INIEM * i]);  /* read keyboard, store in array */

    if(strlen(&items[INIEM * i]) == 0) break;  /* empty key done */

    for(j = 0; j < i; j++)   /* make sure not duplicate key */

    if(strcmp(&items[INIEM * i], &items[INIEM * j], RSIZE) == 0)
        break;             /* exit loop if duplicate found */

    if(i == j) i++;        /* count non-duplicate strings */

    else puts("Duplicate key, try again.");

    ...                    /* sort strings if any entered */

if(i > 0) qsort(items, i, INIEM, strcmp);

    ...                    /* create the output file */
fh = open("TESTFILE.DAT", O_BINARY|O_CREAT|O_RDWR, S_IWRITE);

if(fh == -1)               /* terminate if create failed */
{
    puts("Can't create TESTFILE.DAT.");
    exit(1);
}

    putc(...);             /* writing TESTFILE.DAT... */;

    ...                    /* initialize string counter */

    while (j < i)          /* writing file records */
    {
        memset(rec, 0, RSIZE);
        strcpy(rec, &items[INIEM * j], NSIZE);
        write(fh, rec, RSIZE);
        j++;               /* bump string counter */
    }
    close(fh);             /* release file handle */
}
```

Figure 2: MAKENIF.C creates a data file ordered on ASCII keys entered by the user, resulting in TESTFILE.DAT.

```
/*
SRCHNIF.C  Searches file previously created by MAKENIF.EXE
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PC Magazine • Ray Duncan

The user is prompted to enter a search key.  The first
6 characters of the key are used to search TESTFILE.DAT,
using both the sequential and binary search algorithms.
The success or failure of the search is reported along
with the number of records inspected by each method.

Each record in TESTFILE.DAT is RSIZE bytes long.  Byte
0 to (NSIZE-1) of the record are the ASCII key for searches
by SRCHNIF.C.  Bytes RSIZE to (RSIZE-1) of the record
are initialized to zero and are not used but
must be kept synchronized with their definitions in MAKENIF.C.
*/

#include <stdio.h>
#include <string.h>
#include <stdlib.h>
#include <fcntl.h>
#include <sys\types.h>
#include <sys\stat.h>
#include <io.h>

#define NSIZE    64         /* fixed record size */
#define NSIZE    64         /* maximum key length */

static int inspected;       /* records inspected counter */

main()
{
    int i, j;               /* some scratch variables */
    int fh;                 /* handle for data file */
    int rc;                 /* size of file in bytes */
    int frecs;              /* number of records in file */
    char key[81];           /* key entered by user */
    char rec[RSIZE];        /* scratch record buffer */

    ...                     /* open our data file */
    fh = open("TESTFILE.DAT", O_RDONLY | O_BINARY);

    if(fh == -1)            /* terminate if open failed */
    {
        puts("Can't find TESTFILE.DAT.");
        exit(1);
    }

    fsize = lseek(fh, 0L, SEEK_END);  /* find file size */
    frecs = fsize / RSIZE;  /* calculate number of records */

    printf("\nTESTFILE.DAT contains %ld bytes, %d records.", fsize, frecs)

    while(1)
    {
        printf("\n\nEnter key: ");  /* prompt user and */
        gets(key);          /* read key from keyboard */

        if(key[0] == 0) break;  /* terminate if empty line */

        if(strlen(key) > NSIZE)  /* key truncated to %d characters.", NSIZE);
            printf("\nWarning: key truncated to %d characters.", NSIZE);

        inspected = 0;      /* reset record counter */

        ...                 /* perform sequential search */
                            /* and display results */
        i = seqsearch(fh, key);  /* perform sequential search */
        if(i < 0) printf("\nSequential search result: ");
            else printf("record %d found.", i);  // printf("record not found.");
            else printf("record %d found.", id);
```

Figure 3: SRCHNIF.C, a C program that performs sequential and binary searches on TESTFILE.DAT and displays the results.

```
        printf("   %d records inspected.", inspected);

        inspected = 0;      /* reset record counter */

                            /* perform binary search */
                            /* and display results */
        printf("\nBinary search result: ");
        if(i = binsearch(fh, key, 0, frecs-1) == -1)
            printf("record not found.");
        else
            printf("record %d found.", i);

        printf("   %d records inspected.", inspected);
    }
    close(fh);              /* release file handle */
}
```

```
/*
Search the file sequentially to match the specified key,
called with a file handle and key address.  Returns the record
number if match found, or -1 to indicate no match.
*/

int seqsearch(int fh, char *kptr)
{
    int i;                  /* scratch variable */
    char fbuff[RSIZE];      /* file record buffer */

    lseek(fh, 0L, SEEK_SET);  /* rewind to start of file */

    while(read(fh, fbuff, RSIZE) != 0)  /* do until end of file found */
    {
        inspected++;        /* count records inspected */

        i = strncmp(kptr, fbuff, NSIZE);  /* compare keys */
        if(i == 0) return(inspected-1);  /* if matched, return record no. */
        else if(i < 0) break;  /* if record absent, end search */
    }
    return(-1);             /* no match, return -1 */
}
```

```
/*
Binary search the file to match the specified key,
called with a file handle, key address, and the first
and last record numbers of the file segment being
inspected.  returns the record number if match found,
or -1 to indicate no match.
*/

int binsearch(int fh, char *kptr, int left, int right)
{
    int i;                  /* scratch variable */
    char fbuff[RSIZE];      /* file record buffer */

    if(left > right) return(-1);  /* end search if record absent */

    i = (left + right) / 2;  /* calculate record number */

    inspected++;            /* count records inspected */

    lseek(fh, (long) (i * RSIZE), SEEK_SET);  /* seek to record */
    read(fh, fbuff, RSIZE);  /* read the record */

    j = strncmp(kptr, fbuff, NSIZE);  /* compare keys */

    if(j == 0) return(i);   /* if matched, return record no. */

    else                    /* otherwise bisect file, recurse */
                            /* to inspect next record */
    if(j < 0) binsearch(fh, kptr, left, i-1);
    else      binsearch(fh, kptr, i+1, right);
}
```

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```
; BSEARCH.ASM -- General purpose binary search routine (MS-DOS version)
; Copyright (c) 1989 Ziff Communications Inc.
; PC Magazine * Ray Duncan
;
; Call with:    BX = file handle
;               CX = record length
;               DX:AX = record buffer address
;               DI = first (left) record number
;               SI = last (right) record number
;               DS:BP = key structure address
;
;        where the key structure is:
;               dw    a     length of key
;               dw    b     offset of key in record
;               AX    = key value
;
; Returns:      if record found
;                   Zero flag = set
;                   SI = record number
;               if record not found
;                   Zero flag = clear
;                   AX = undefined
;
;           All other registers preserved

_TEXT   segment word public 'CODE'

        extrn   strncmp:near

        assume  cs:_TEXT

kbuff   equ     dword ptr [bp]          ; key address
right   equ     word ptr [bp+4]         ; last record number
left    equ     word ptr [bp+6]         ; first record number
flen    equ     word ptr [bp+8]         ; file record size
fhandle equ     word ptr [bp+14]        ; file handle

        public  bsearch
bsearch proc    near

        cmp     di,si                   ; first > last record?
        jng     bsch1
        ret                             ; record absent, search

bsch1:  push    bx                      ; save registers
        push    cx
        push    dx
        push    ds
        push    es
        push    di
        push    si
        push    bp

        mov     bp,sp                   ; point to stack frame

bsearch endp

_TEXT   ends

        mov     ax,si                   ; calculate record number
        add     ax,di                   ; at middle of file segment
        shr     ax,1                    ; (left + right) / 2
```

```
        push    ax                      ; save record number

        mul     cx                      ; set CX:DX = file offset
        xchg    cx,ax                    ; (BX already = handle)
        mov     ax,4200h                ; set file pointer, random
        int     21h                     ; transfer to MS-DOS

        mov     cx,flen                 ; one read record ...
        lds     dx,fhuff                ; DS:DX = record buffer
        mov     ah,3fh                  ; read file
        int     21h                     ; transfer to MS-DOS

        lea     di,kbuff                ; ES:DI = key structure
        mov     si,dx                   ; DS:SI = record buffer
        add     si,es:[di+2]            ; DS:SI = key within record
        mov     cx,es:[di]              ; CX = length of key
        add     di,4                    ; ES:DI = address of key
        call    strncmp                 ; now compare keys

        pop     ax                      ; recover record number
        jz      bsch4                   ; match found, exit

        mov     bx,fhandle              ; set up to bisect file and
        mov     cx,flen                 ; perform recursive search
        lds     dx,right
        mov     ax,di

        js      bsch3                   ; hrsch on key comparison

bsch2:  mov     di,ax                   ; record < search key
        inc     di                      ; set right = current - 1
        jmp     bsch3

bsch3:  mov     si,ax                   ; record > search key
        dec     si                      ; set left = current + 1
bsch4:  call    bsearch                 ; inspect next middle record

        pop     bp                      ; restore registers
        pop     si
        pop     di
        pop     es
        pop     ds
        pop     dx
        pop     cx
        pop     bx

        ret                             ; and return to caller

bsearch endp

_TEXT   ends
```

Figure 4: *BSEARCH.ASM is a general-purpose binary search engine for assembly language programs.*

```
; TRYBSRCH.ASM Demo of BSEARCH routine (MS-DOS version),
;       searches file previously created by MAKEHIP.EXE.
; Copyright (c) 1989 Ziff Communications Inc.
; PC Magazine * Ray Duncan
;
; The user is prompted to enter a search key. The first
; 8 characters of the key are used to search TRYFILE.DAT,
; using the binary search algorithm. The success or failure
; of the search is reported along with the record number (if found).
;
; Each record in TESTFILE.DAT is RSIZE bytes long. Bytes
; 0 to (KSIZE-1) of the record are the ASCII key for searches
; by entAdd0.  bytes RSIZE to (RSIZE-1) of the record
; are initialized to zero and are not used. RSIZE, KSIZE,
; and the key offset within the record must be kept synchronized
; with MAKEHIP.C.
;
; To build TRYBSRCH.EXE you also need BSEARCH.ASM, ITOA.ASM,
; and STRINGSI.ASM. Enter the following series of commands:
;
;       MASM TRYBSRCH;
;       MASM BSEARCH;
;       MASM ITOA;
;       MASM STRINGS;
;       LINK TRYBSRCH+BSEARCH+ITOA+STRINGSI;

stdin   equ     0       ; standard input handle
stdout  equ     1       ; standard output handle

cr      equ     0dh     ; ASCII carriage return
lf      equ     0ah     ; ASCII line feed
blank   equ     20h     ; ASCII blank

rsize   equ     64      ; TESTFILE.DAT record size
ksize   equ     8       ; TESTFILE.DAT key size
koffs   equ     0       ; offset of key within record

_TEXT   segment word public 'CODE'
```

```
        assume  cs:_TEXT,ds:_DATA

        extrn   itoa:near
        extrn   bsearchnear:near

main    proc    near

        mov     ax,_DATA                ; make our data segment
        mov     ds,ax                   ; addressable...

        old                             ; string ops safety first

        mov     dx,offset fname         ; open the file TESTFILE.DAT
        mov     ax,3d00h                ; fxh 3d00h = open, read-only
        int     21h                     ; transfer to MS-DOS
        jnc     main1                   ; jump if open successful

        mov     dx,offset msg1          ; open failed, display error
        mov     cx,msg1_len             ; message and exit...
        mov     bx,stdout               ; BX = standard output handle
        mov     ah,40h                  ; fxn 40h = write
        int     21h                     ; transfer to MS-DOS
        jmp     main4                   ; go perform final exit

main1:  mov     fhandle,ax              ; save file handle
        mov     dx,seg1_len             ; find filesize in bytes...
        mov     bx,ax                   ; BX = handle
        mov     cx,0                    ; CX:DX = file offset of 0
        mov     ax,4202h                ; set pointer relative
        mov     ax,4202h                ; relative to end of file
        int     21h                     ; transfer to MS-DOS
```

Figure 5: *TRYBSRCH.ASM demonstrates the use of the BSEARCH routine on the TESTFILE.DAT file.*

filesize / bytes per record

(continues)

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```
        div     bx              ; = records in file
        mov     frecs,ex
                                ; display "Enter seerch key: "
main2:  mov     dx,offset msg2  ; DS:DX = messege address
        mov     cx,msg2_len     ; CX = message length
        mov     bx,stdout       ; BX = handle
        mov     ah,40h          ; Fxn 40h = write
        int     21h             ; transfer to MS-DOS

        mov     cx,ksize        ; zero out previous key
        mov     di,offset kval
        xor     al,al
        rep stoab

        mov     cx,6            ; remove previous record
        mov     di,offset msg3a ; number from output string
        mov     al,blenk
        rep atoab
                                ; get search key from user
        mov     dx,offset kvel  ; DS:DX = input buffer
        mov     cx,80           ; CX = max input length
        mov     bx,stdin        ; BX = handle
        mov     ah,3fh          ; Fxn 3Fh = read
        int     21h             ; transfer to MS-DOS

        cmp     ex,2            ; wes enything entered?
        je      main4           ; empty line, exit

        mov     bx,ex           ; remove CR-LF from input
        mov     word ptr [bx+kval-2],0

                                ; set up for binary seerch
        mov     bx,fhandle      ; file handle
        mov     cx,rsize        ; record size
        mov     dx,offset bfuff ; record buffer
        mov     ai,0            ; first (left) record
        mov     di,frecs        ; last (right) record
        dec     di
        mov     bp,offset key   ; key structure address
        call    bsearch         ; cell seerch routine
        jnz     main3           ; jump if record not found

        mov     si,offset msg3a ; convert record number
        mov     cx,10           ; to ASCII and store in output
        call    itoe
                                ; displey 'Record number is nnnn'
        mov     dx,offset msg3  ; DS:DX = messege address
        mov     cx,msg3_len     ; CX = message length
        mov     bx,stdout       ; BX = standerd output handle
        mov     eh,40h          ; Fxn 40h = write
        int     21h             ; transfer to MS-DOS

        jmp     main2           ; get another search key

main3:                          ; displey 'Record not found'
```

```
        mov     dx,offset msg4  ; DS:DX = message eddress
        mov     cx,msg4_len     ; CX = messege length
        mov     bx,stdout       ; BX = standerd output handle
        mov     eh,40h          ; Fxn 40h = write
        int     21h             ; transfer to MS-DOS

        jmp     main2           ; get another search key

main4:  mov     ax,4c00h        ; finel exit to MS-DOS
        int     21h

main    endp

_TEXT   ends

_DATA   segment word public 'DATA'

fname   db      'TESTFILE.DAT',0 ; file creeted by MAKENIF.C
fhendle dw      ?               ; hendle for TESTFILE.DAT
frecs   dw      ?               ; records in file
bfuff   db      rsize dup (0)   ; file record buffer

key     dw      ksize           ; length of key date
        dw      koffs           ; offset of key within record
kvel    db      80 dup (0)      ; ectual key dete

msg1    db      cr,lf
        db      'Cen''t open TESTFILE.DAT'
        db      cr,lf
msg1_len equ    $-msg1

msg2    db      cr,lf
        db      'Enter seerch key: '
msg2_len equ    $-msg2

msg3    db      cr,lf
        db      'Record number is: '
msg3a   db      6 dup (blenk)
        db      cr,lf
msg3_len equ    $-msg3

msg4    db      cr,lf
        db      'Record not found'
        db      cr,lf
msg4_len equ    $-msg4

_DATA   ends

STACK   segment pere stack 'STACK'

        db      4096 dup (?)

STACK   ends

        end     main
```

(Figure 5 ends)

NONINDEXED FILE TESTBEDS
One of the reasons personal computers are so much fun to program is that they give you the chance to try things out interactively. The program examples in this installment of Power Programming will let you play around with nonindexed files to your heart's content.

The first program, MAKENIF.C (Figure 2), creates an ordered random access file that can be searched by the other programs included here. It prompts you for up to 100 short, unique ASCII strings. When you press Enter by itself in response to the prompt, the program sorts the strings and creates a file named TESTFILE.DAT, in which each string is the key field of a record. (For this simple demonstration, key fields are limited to eight characters and the remainder of each 64-byte record is empty.)

The second program, SRCHNIF.C (shown in Figure 3), opens the TEST-FILE.DAT file and prompts you for a key

for which to search. It then reports whether the record that you are looking for exists and (if present) how many records had to

■ One of the reasons that personal computers are so much fun to program is that they give you the chance to try things out interactively.

be inspected—both by the sequential and binary search methods—in order to locate the desired record.

These two programs are written in plain-vanilla C and can be used under MS-

DOS or OS/2 without any changes. To compile the programs, enter the commands

```
CL MAKENIF.C
CL SRCHNIF.C
```

Run MAKENIF.EXE first, to create a data file, and then run SRCHNIF.EXE to experiment with it. You can terminate SRCHNIF.EXE at any time by pressing Enter alone, Ctrl-C, or Ctrl-Break in response to a prompt.

Figure 4 contains the BSEARCH.ASM routine, which is a general-purpose binary search engine for assembly language programs. It is called with a file handle, the record size, and the numbers of the first and last records to search. The B-SEARCH.ASM routine invokes itself recursively, successively bisecting the file until the record is discovered or shown to be absent, and it returns the status of the search in the carry flag and in register AX. The specific arguments and results for the

routine are shown in the listing.

TRYBSRCH (Figure 5) is a simple demonstration program that prompts the user for a key value and then searches the file created by MAKENIF.EXE. To assemble and link TRYBSRCH.ASM into the executable file TRYBSRCH.EXE, you will also need the modules BSEARCH.ASM (contained here), STRINGS1.ASM (from our November

■ **TRYBSRCH.ASM is a simple demonstration program that prompts the user for a key value and then searches the file created by MAKENIF.EXE.**

15, 1988, issue) and ITOA.ASM (February 29, 1988).

Bring all these files together in the same directory and enter the following command sequence:

```
MASM /I TRYBSRCH;
MASH /I BSEARCH;
MASM /I ITOA;
MASM /I STRINGS1;
LINK /CO TRYBSRCH+BSEARCH+ITOA+STRINGS1;
```

If you aren't interested in tracing TRYBSRCH.EXE's execution with CodeView, you can omit the /Zi and /CO switches. The use of TRYBSRCH.EXE is self-explanatory, and you can exit from the program by responding to a prompt with an empty line or by entering Ctrl-C or Ctrl-Break.

The OS/2 versions of TRYBSRCH .ASM and BSEARCH.ASM aren't shown here for reasons of space but can be downloaded from PC MagNet.

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■ DOUGLAS COBB AND STEVEN COBB

SPREADSHEET CLINIC

Printing column letters and row numbers on a 1-2-3 worksheet; trapping illegal filenames using the {Open} command; avoiding the limitations of 1-2-3's wildcard.

The @FIND function overcomes the limitations of 1-2-3's * wildcard

Like DOS, *Lotus 1-2-3* ignores any characters that follow the * wildcard. The criterion M*R selects the same records as M*; specifically, any records that have an entry beginning with M in the field into which you entered this criterion. Similarly, the criterion MI* selects every record in the database—not just the records that have the characters MI somewhere within the field into which you entered this criterion.

In order to find all records whose entries in a specific field contain a particular sequence of characters at any position within those entries, use this wildcard:

```
@FIND(string,cell,0)+1
```

For example, to find all records in the database in Figure 1 whose entry in the Lastname field contains the letters MI, you would enter

```
@FIND("MI",B5,0)+1
```

into a cell in the first row of the criterion range (in this case, cell B2). Then issue the /Data Query Find command (or any other criterion-using command). *1-2-3* will evaluate this criterion for each of the records in the database.

If an entry in the Lastname field contains the characters MI, the @FIND function will return the offset of the M relative to the first character in that entry. For example, if the entry begins with the characters MI, the @FIND function will return the value 0. If M and I are the second and

third characters, the @FIND function will return the value 1. If the entry in the Lastname field does not contain the letters MI, then the @FIND function will return the value ERR.

Adding 1 to the result of the @FIND function assures that *1-2-3* will select all records whose entry in the Lastname field begins with the letters MI. To *1-2-3*, the results of ERR and ERR are false, and any other value is true. Unless you add 1 to the result of the @FIND function, *1-2-3* will not select records whose entry in the Lastname field begins with the letters MI. Since adding 1 to any positive value produces a value other than 0 or ERR, *1-2-3* also will select records having MI anywhere else in their Lastname field. However, since ERR+1=ERR, *1-2-3* will not select records whose Lastname entry does not contain the letters MI.—*Leonardo Daniel Faivisovich; Buenos Aires, Argentina*

This technique can be expanded to overcome other limitations of *1-2-3*'s wildcard. In order to find all records whose Lastname entry contains the letters M and R, with the R positioned anywhere after

the M, you could use either

```
@FIND("M",B5,0)+0FIND("R",B5,@FIND("M",B5,0))
```

or the criterion

```
@FIND("R",B5,0)>@FIND("R",B5,0)
```

To find all records whose Lastname entries contain M and end with R, use

```
@FIND("M",B5,0)+1#AND#@RIGHT(B5,1)="R"
```

The criterion

```
@LEFT(B5,1)="H"#AND#@FIND("R",B5,0)
```

would find all records whose Lastname entries begin with H and contain M.

Finally, to find all records whose Lastname entries begin with H and end with R, you could use

```
@LEFT(B5,1)="H"#AND#@RIGHT(B5,1)="R"
```

The {Open} command offers a better way to trap nonexistent files

I need many of my *1-2-3* macros to determine if a particular file exists. For example, to prevent a macro error, I may want a

Figure 1: You can use the @FIND function to locate records that have a particular sequence of characters anywhere within the field you specify. Cell B2 of the above worksheet contains the criterion formula @FIND(''MI'',B5,0)+1.

	A	B	C	D	E	F
1	Firstname	Lastname	Street		City	State Zip
2		1				
3						
4	Firstname	Lastname	Street		City	State Zip
5	JOHN	MILLER	325 SHIPWAY PLACE		DEVON	PA 12345
6	RICK	HAMMER	123 SAN MIGUEL DRIVE		DALLAS	TX 23456
7	PAT	SMITH	293 TURTLE CREEK		SAN MATEO	CA 34567

■ SPREADSHEET CLINIC

macro to determine if a file specified by a user exists before the macro issues the /File Combine command.

To test for a file's existence, I use 1-2-3's {Open} command. If the file specified by an {Open} command does not exist, 1-2-3 will execute the remaining commands in the cell that contains the {Open} command. In my macros, these commands instruct 1-2-3 to beep and then route the execution of the macro to a command that resolicits the filename. However, if the file specified does exist, 1-2-3 will skip the {Beep} and {Branch} commands and continue with the macro.

The macro shown in Figure 2 demonstrates this technique. The first statement solicits a filename from the user and stores his response into the cell named FILENAME (B8). Next, the macro commands instruct 1-2-3 to open the file whose name is stored in FILENAME (B8). If this exists, 1-2-3 will skip, the {Beep} and {Branch} commands, and proceed to the statements in cells B3 and B4, which close the open file and then combine it into the current worksheet.

If the file does not exist, 1-2-3 won't be able to open it and will execute the {Beep} command. Then it will execute the command {Branch ERROR}, which routes the execution of the macro to the cell named ERROR (B6). The commands in this cell resolicit the filename, then route the macro back to cell B2, which tests the validity of the new name.—*Deena Eliosoff; Montreal, Quebec, Canada*

This technique is an improvement over using the {OnError} command to trap the names of nonexistent files. To assure that the file is not modified in any way, the macro opens it in the read-only mode, then closes it immediately.

The macro in Figure 3 shows how you could use the {OnError} command to check for the existence of a file. The first statement tells 1-2-3 to route the execution of the macro to the cell named ERROR (B5) in the event of a macro error. Next it solicits a filename from the user and enters it into the cell named FILENAME (B9).

The third statement attempts to combine the file whose name is stored in FILENAME into the current worksheet. If the file exists, 1-2-3 will combine it and end the execution of the macro. If the file does not exist, a macro error will occur. Because of the error trap set by the statement in cell A1, 1-2-3 will route the execution

of the macro to the cell named ERROR (B5) at this point. The first statement in ERROR resets the error trap. The next instructs 1-2-3 to beep. Finally, it resolicits the filename, then branches the execution of the macro back to cell B3, which reissues the /File Combine command.

Productivity Tip

If you use *Symphony*, Release 1.0, 1.01, 1.1, or 1.2, you can change the case of a character in a DOC window by moving the cursor to that character and pressing Ctrl-C. If you use *Symphony*, Release 2.0, you must use the Ctrl-X combination instead—the Ctrl-C combination will issue the {Menu} Copy command.

Printing column letters and row numbers on a 1-2-3 worksheet

When I print large spreadsheets, I often want the letter(s) of each column (for example, A, BD, and so forth) to appear at the top of the printout, and the number of each row (for example, 1, 53, and so forth) to appear at the left edge of each row. To do this, I insert a new row at the top of the worksheet and a new column at the left edge of the worksheet. Then I enter the letter(s) of each column into the cells of row 1, and I enter the number of each row into the cells of column A.

To enter the row numbers into the cells of column A, I use *Lotus 1-2-3*'s Range Fill command. For example, to fill cells A2..A20 with the values 2 through 20, I issue the /Data Fill command, specify A2..A20 as the Fill range, specify a start value of 2, a step value of 1, and a stop value greater than 20.

Filling the cells of row 1 with column letters is more difficult. In fact, I used to type them by hand. I would type the label 'B into cell B1, the label 'C into cell C1, the label 'D into cell D1, and so forth. After entering them I used the /Range Label Center command to center them.

I knew there had to be a better way. Now, I enter the formula

Figure 2: This macro uses an {Open} command to determine if the file specified by the user exists before it issues the /File Combine command.

	A	B	C	D	E	F	G	H
1	\c	{GetLabel "File to combine: ",FILENAME}						
2	TEST	{Open FILENAME,"R"}{Beep}{Branch ERROR}						
3		{Close}						
4		/fcce{FILENAME}~						
5								
6	ERROR	{GetLabel "File does not exist. Try again: ", FILENAME}{Branch TEST}						
7								
8	FILENAME							

Figure 3: This macro uses an {OnError} command instead of an {Open} command (shown in Figure 2) to trap illegal filenames.

	A	B	C	D	E	F	G
1	\c	{OnError ERROR}					
2		{GetLabel "File to combine: ",FILENAME}					
3	COMBINE	/fcce{FILENAME}~					
4							
5	ERROR	{OnError ERROR}					
6		{Beep}					
7		{GetLabel "File does not exist. Try again: ", FILENAME}{Branch COMBINE}					
8							
9	FILENAME						
10							

```
@REPEAT(" ",@INT((@CELL("width",B1..B1)-
@IF(@CELL("col",B1..B1)<27,1,2))/2))
&@MID(@CELL("address",B1..B1),1,
@IF(@CELL("col",B1..B1)<27,1,2))
```

into cell B1. This formula returns a string that consists of the letter B (the letter of the column in which the formula is situated), padded with as many leading spaces as are required to center it within that column. For example, if column B were nine spaces wide, this formula would return the five-character string "   B" (note the four leading spaces).

Once I have entered this formula in cell B1 (you can use a macro to do this, if you wish), I copy it into as many cells to the right of cell B1 as I wish to fill with column letters. Because the references in the formula are relative, each formula references the column in which it is situated.

For example, copying this formula into cell C1 would produce the following formula:

```
@REPEAT(" ",@INT((@CELL("width",C1..C1)-
@IF(@CELL("col",C1..C1)<27,1,2)/2))
&@MID(@CELL("address",C1..C1),1,
@IF(@CELL("col",C1..C1)<27,1,2))
```

If column C were 12 spaces wide, this formula would return the six-character string "   C". (Again, note the five leading spaces.) Similarly, copying this formula into cell AB1 would produce the following formula:

```
@REPEAT(" ",@INT((@CELL("width",AB1..AB1)-
@IF(@CELL("col",AB1..AB1)<27,1,2)/2))
&@MID(@CELL("address",AB1..AB1),1,
@IF(@CELL("col",AB1..AB1)<27,1,2))
```

If column AB were 12 spaces wide, this formula would return the seven-character string "   AB".

In addition to saving keystrokes, this method of entering column letters has another advantage: you don't have to change the entries after inserting or deleting columns from the worksheet. After you insert a new column, simply copy the formula from the first cell in the column to its left or right to the first cell of the new column, then recalculate the worksheet. Similarly, after you delete a row, simply recalculate the worksheet. A simple recalculation also changes the results of these formulas to reflect altered column widths.—*A. M. Platt; Richland, Washington*

This useful formula uses an @MID function to extract the column letters from the result of an @CELL("address") function. @CELL("address") returns the absolute address of the cell that it references. For

example, the function @CELL("address",B1..B1) returns the string B1, and the function @CELL("address",AB1..AB1) returns the string AB1. For columns identified by one letter, that letter is the second character in the result of the @CELL("address") function; for columns identified by two letters, those letters are the second and third characters in the result of the @CELL("address") function.

Since these formulas reference the cells in which they are situated, they are circular in nature. Although this circularity does not affect the result of these formulas, it may obscure unintentional circular references in the worksheet. To eliminate this circularity, you can modify the references in each formula to refer to cells in rows other than 1. Unfortunately, this approach makes it possible to delete the row(s) containing the cells referred to by these formulas. If you delete these rows, *1-2-3* will replace the references in the formulas with the value ERR.

You can use a similar (but simpler) technique to enter "dynamic" row numbers into the cells of column A. To do so, enter the formula

```
@STRING("row",A2..A2),0)
```

into cell A2, then copy it into as many cells (below that cell) as you want to fill with row numbers. Each formula will return the string form of the number of the row in which it is situated. These will be aligned with the left edge of their cells, just as the row numbers in the left border of a spreadsheet are aligned. If you use @CELL("row") functions without @STRING functions, they will return right-aligned values.

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■ NEIL J. RUBENKING

USER-TO-USER

A batch file that accepts synonyms for command-line arguments; determine whether a directory is nonexistent or only empty; list multiple filespecs by expanding DIR power.

Do you have a disk that's been mangled in transit? Here's a surgical solution

Floppy disks can get damaged in the mail, especially if they're not packed well. If the black plastic envelope is crimped or mashed, the disk may not spin properly, and you won't be able to read it. Here's a last-ditch method that often works after all other attempts to retrieve the data have failed.

You will need a scratch diskette, a blank formatted diskette, and a sharp knife. Using the knife, carefully slit one side of the plastic envelope of the damaged diskette and the scratch diskette. Don't slit the side with the write-protect notch or the side near the oval opening. Remove the actual magnetic disk from the scratch diskette and discard it. Now very carefully, with clean dry fingertips, remove the magnetic disk from the damaged diskette and slip it into the envelope of the scratch diskette. Insert the transplanted diskette into a disk drive and try to read it. If you're successful, *immediately* copy all the files to the formatted diskette.

Patch PC-DOS 3.3 to clear the screen in living color

In previous User-to-User columns (December 10, 1985, and October 28, 1986), you have shown how to patch COMMAND.COM to make the CLS command produce colors. The latest DOS version cannot use either of these patches, since the location of the clear screen routine is different. Here is a DEBUG script file to apply the color patch to IBM PC-DOS 3.3's COMMAND.COM.

Using a word processor that produces ASCII text, type the script file in Figure 1. Be sure to include the blank lines before the W and after the Q. Save this text as COLOR33.SCR and copy it to a bootable disk along with DEBUG and COMMAND.COM. Then type in the following at the DOS prompt:

```
DEBUG < COLOR33.SCR
```

DEBUG will read the script file and automatically patch the copy of COMMAND .COM. If you boot up from the diskette with the patched COMMAND.COM you'll find that the CLS command now produces yellow text on a blue background. Only patch a copy of COMMAND.COM, not the original! In the patched version, the color attribute byte is at offset 2BA7h and the border color is in 2BB5h.—*Jack A. Orman; Southaven, Mississippi*

With ANSI.SYS and its clones readily available, it's not 100 percent clear to me why you would need to patch COMMAND.COM this way. However, ANSI does take almost 2K of RAM. So if you can't afford the 2K and still want color at the DOS prompt, this patch will help you.

The DEBUG script in Figure 1 actually performs two patches. The first simply changes the byte that controls screen color from 07h (white on black) to 1Eh (yellow on blue). The second patch sets the border color to blue also. It does this by moving a chunk of COMMAND.COM from one location to another and then adding new in-

```
N COMMAND.COM
L
E 2BAD 1E
M CS:2B9D 2BB9 CS:2B97
A 2B B4
MOV BL,Ø1
MOV AH,ØB

W
Q
```

Figure 1: *This DEBUG script patches DOS 3.3 COMMAND.COM so the CLS command gives a yellow-on-blue screen.*

DOS Color Chart

Color	Background or dim foreground	Bright foreground
Black	0	8
Blue	1	9
Green	2	A
Cyan	3	B
Red	4	C
Magenta	5	D
Yellow	6	E
White	7	F

Figure 2: *Use the chart above to find the hexadecimal number that corresponds to your own preferred DOS color.*

■ USER-TO-USER

structions in the space created by the move. The border-setting code won't work with an EGA, so if you have EGA or if you simply don't care about the border color, eliminate the second patch by deleting lines 4 through 8 in the script. (You will actually be deleting five lines, beginning with the line that starts with M up to and including the blank line before the W.)

You can modify COLOR33.SCR to set a color scheme besides bright yellow on blue. The chart in Figure 2 lists the hexadecimal bytes that describe the colors you can choose from. It will contain two digits, the first for the background and the second for the foreground. For example, to select dim red letters on a white background, you'd use 74. Substitute this value for 1F in the third line of the script. Now substitute the background digit for the 1 in the sixth line. In the red-on-white example, you'd change that line to MOV BL,07.

Once you've patched COMMAND .COM to your satisfaction, you'll want to store away the original and the patched copy on your boot disk. Do *not* leave both copies of COMMAND.COM on your system. If you boot up with one and then accidentally load the other, you'll crash your system with an "Invalid COMMAND .COM" message.

Expand your DIR power to list multiple filespecs

DIR is probably the most frequently used DOS command. Although very helpful, DIR is limited to a file list that matches just one filespec. I often need to view a directory of more than one file type or even a di-

rectory of several disks or subdirectories. This normally requires multiple DIR commands.

MULTIDIR.BAT, in Figure 3, accepts multiple filespecs and lists the directories of each. The number of parameters passed is limited only by the length of the command line. For example, to list all .BAT files on drive C: and all .EXE files on drive A:, enter

    MULTIDIR C:*.BAT A:*.EXE

You can edit MULTIDIR to suit your own needs. For instance, you may want to substitute the DIR/W option (for DIR/P) to produce a wide directory listing.—*Jack E. McCoy; Deep Run, North Carolina*

The DOS command line can hold 128 characters, including the name of the command. And command-line parameters must be separated by a space. Hence, the absolute maximum number of parameters is 63, assuming a one-character command name and one-character parameters. You'll probably never approach that limit, but you *might* need more than the basic nine replaceable parameters. SHIFT discards parameter %0 and bumps up every other command-line parameter one number: %2 becomes %1, and so on. MULTIDIR just keeps shifting until parameter %1 is empty, meaning it has reached the end of the parameter list.

Give your batch file arguments multiple options

A batch file that accepts synonyms for command-line arguments is nice for the

```
ECHO OFF
IF "%1"=="" GOTO ERROR
DIR %1
DIR %1 /p
PAUSE
SHIFT
IF "%1"=="" GOTO EXIT
GOTO DIR
:ERROR
ECHO SYNTAX    "MULTIDIR filespec1 [filespec2 [..]]"
:EXIT
```

Figure 3: *The MULTIDIR.BAT file allows you to request directory listings of as many filespecs as you are able to fit on the DOS command line.*

PRODUCTIVITY

user. However, if a test for an argument needs to occur several times in the file, testing for all synonyms each time can be tedious.

Instead, for each set of options designate just one as a major option. Then, at the beginning of the file, you could test whether a major option was used. If so, jump to the working part of the batch file. If a synonym was used, have the batch file re-call itself using the appropriate major option. Figure 4 shows a sample application.—*James A. Luedke, Jr.; Wellesley, Massachusetts*

```
ECHO OFF
:XBACKUP.BAT -- backup options example
FOR %%v IN (F I) DO IF (%1)==(%%v) GOTO START
FOR %%v IN (f FULL full Full) DO IF (%1)==(%%v) %0 F
FOR %%v IN (i INC inc Inc INCREMENTAL) DO IF (%1)==(%%v) %0 I
FOR %%v IN (incremental Incremental) DO IF (%1)==(%%v) %0 I
GOTO ERROR
:BEGIN
IF (%1)==(F) ECHO Start a full backup ...
IF (%1)==(I) ECHO Start an incremental backup ...
GOTO END
:ERROR
ECHO You didn't choose any of the MANY possible parameters.
:END
```

Figure 4: *The batch file OPTIONS.BAT, shown above, accepts many synonyms for its command-line parameters. Using this technique you could also test for a drive letter.*

Accepting synonyms is certainly friendlier than halting with a message "ERROR: Only X or Y are valid here." It's a nice use of FOR to speed things along. Another common batch file event that could benefit from using this technique is testing for a drive letter. For example:

```
FOR %%v IN (A: B:) DO IF %1==%%v GOTO START
FOR %%v IN (a A a:) DO IF %1==%%v %0 A:
FOR %%v IN (b B b:) DO IF %1==%%v %0 B:
```

After this test, you know that parameter 1 contains a valid drive letter followed by a colon.

Distinguish a nonexistent directory from one that's merely empty

Here's a neat way to see if a directory actually exists before working with it in a batch file. Just check the existence of the device name NUL in that directory. NUL always exists, so if there's an error you can bet that

the directory is invalid. It is also handy in languages for the same purpose. Try

```
if(fopen="\\bin\\NUL","r") == NULL;)
```

for the same result in C.—*Howard Urban; Norwalk, Connecticut*

Clever idea! I have used

```
IF EXIST <directory>\*.*
```

before, but it doesn't distinguish between a nonexistent directory and one with no files. The NUL device (along with AUX,

CON, and PRN) exists regardless of directory. If the EXIST test for NUL fails in a directory, then the *directory* doesn't exist.

EXISTDIR.BAT in Figure 5 demonstrates the difference between the two methods. Pass it a directory name as a parameter and it reports whether the directory is nonexistent, present but empty, or present with files in it.

```
ECHO OFF
IF "%1"=="" GOTO NOPARAMS
IF NOT EXIST %1\*.* GOTO MAYBE
ECHO The directory "%1" exists and has files in it.
GOTO END
:MAYBE
IF NOT EXIST %1\NUL GOTO NOTEXIST
ECHO The directory "%1" exists, but no files in it.
GOTO END
:NOTEXIST
ECHO The directory "%1" does not exist.
GOTO END
:NOPARAMS
ECHO SYNTAX "EXISTDIR directoryname"
:END
```

Figure 5: *A batch file that determines whether a directory exists.*

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■ EDITED BY CRAIG L. STARK

POWER USER

A simple way to avoid bypassing your error trapping in Clipper and FoxBASE programs; converting ASCII database files to WordPerfect merge files.

Here's a macro that converts comma-delimited ASCII database files to *WordPerfect* merge files

When I switched to *WordPerfect*, I could no longer use the ASCII-delimited data files created by *dBASE*'s COPY DELIMITED command for form-letter merging. *WordPerfect* uses a different format.

In an ASCII-delimited file, fields are separated by commas, and each record is terminated by a hard carriage return. Character fields are enclosed in double quotes. In a *WordPerfect* data file, on the other hand, fields are separated by a Merge R and each field occupies a separate line. Records are terminated by a Merge E that occupies a line of its own.

The DBCONVRT macro shown in Figure 1 converts ASCII-delimited files into *WordPerfect* merge file format. DBCONVRT looks for all the hard returns and replaces them with a Merge R (^R), a hard return, a Merge E (^E), and another hard return. Next, it searches for all the commas and replaces them with a Merge R and a hard return. Finally it searches for the rest of the double quotes and replaces them with nothing.

If the last field in the ASCII file is enclosed in double quotes, the last step above could leave a blank space before the last Merge R in that record. Thus, DBCONVRT goes on to replace all occurrences of space-Merge R with a simple Merge R.

There could also be a Ctrl-Z (^Z) character at the end of the ASCII file. Some programs, such as *dBASE III+*, insert this end-of-file marker at the end of ASCII files. The last step of the macro eliminates this ^Z. DBCONVRT goes to the end of the file, searches backward for the last Merge E and hard return, and then deletes to the end of the page. This gets rid of everything (in this case, the ^Z) after the final Merge E and hard return.

To use DBCONVRT, load your ASCII-delimited data file into *WordPerfect*. If any records take up more than one line, set your margins so they don't. Execute the macro DBCONVRT by pressing Alt-F10 and supplying the macro name. Afterwards, reset the margins. Save the resulting file and use it as the secondary file when you execute the merge (Ctrl-F9).—*Lee Combs; Davisburg, Michigan*

Almost any database or personal information manager can export information into comma-delimited ASCII files. This handy macro makes those files immediately accessible as *WordPerfect* merge files. The original macro was written for *WordPerfect* 4.2, but it's easy to fix it up for *WordPerfect* 5.0. In *WordPerfect* 4.2, Shift-F9 immediately inserts a Merge E (^E). In Version 5.0 you must press the E key *after* Shift-F9.—*Neil J. Rubenking*

You can use *WordPerfect*'s cut-and-paste buffer as a third document

An undocumented feature in *WordPerfect*, Version 4.2, provides an alternative way to save to and retrieve from the temporary

```
<Ctrl-F10>                          Begin macro definition
DBCONVRT<CR>                        Get to the top
<Home><Home><Up>                    Find and replace without confirm
<Alt-F2>n                           Find hard returns ...
<CR><F2>                            ... and replace with Merge R code, hard return,
<CR><F9><CR><Shift-F9><CR><CR><F2>  Merge E code and another hard return
<Alt-F2>n                           Get to the top
,<F2>                               Find and replace without confirm
<F9><CR><F2>                        Find commas ...
<Home><Home><Up>                    ... and replace with Merge R code followed
<Alt-F2>n                           by a hard return
"<F2>                               Get to the top
<F2>                                Find and replace with confirm
<Home><Home><Up>                    Find character " ...
<Alt-F2>n                           ... and replace with nothing
<Space><F9><F2>                     Find and replace without confirm
<F9><F2>                            Find a space and Merge R ...
<Home><Home><Down>                  ... and replace with a Merge R
<Shift-F2>                          Get to the bottom
<Shift-F9><F2>                      Search backwards
<Home><Home><Up>                    Find last Merge E and hard return
<Ctrl-PgDn>                         Delete to end of page
<Ctrl-F10>                          Get to the top
                                    End macro definition
```

Figure 1: *The macro DBCONVRT changes a comma-delimited ASCII file into a WordPerfect merge file.*

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save buffer. There is also a way you can append to the buffer. By taking advantage of these facilities, the buffer can become, in effect, a "third document."

To save to the buffer, block the text with Alt-F4, press the Save key (F10), and simply press Enter when you're asked for a block name. You can similarly retrieve the text with Shift-F10, again pressing Enter when asked for a document name. Since these two methods use function keys only (no numbers), they're handy for people like me who often confuse the function keys along the top of the keyboard with the number keys on the row below.

The fact that you can append text to it gives the temporary buffer its real power. This is especially useful for combining text from document 1 and document 2. To do this, start by using one of the methods described above to save your first piece of text. Then, for each additional piece of text you want to include in your "third document," block it and then press <Ctrl-F4>3 (move, append). Hit Enter when asked for a document name. The buffered "third document" will grow with each Append and can be retrieved at any time by using one of the methods above.

Note: Include a hard return or trailing spaces at the end of each piece of appended text because it will be appended *exactly* at the point where the previous text ends. Without hard returns or trailing spaces, you will soon have a very long, continuous piece of text in the buffer.—*Paul C. Hardin; Champaign, Illinois*

With only one change, Mr. Hardin's technique will work equally well in WordPerfect 5.0. To append, you press <Ctrl-F4>3a rather than <Ctrl-F4>3. Note also that you can't use the cut-and-paste block features for anything *else* while you're accumulating text in the temporary buffer. If you move or copy a block, that block will take the place of the text in your "third document."

When you Move or Copy text in WordPerfect 5.0, you must immediately move the cursor to the new location for that text and hit Enter. If you'd rather put that text into the cut-and-paste buffer for later retrieval, the F10-Enter sequence does it. This may prove easier for users accustomed to Version 4.2.—*Neil J. Rubenking*

Here's the way to avoid accidentally bypassing your error trapping in Clipper and FoxBASE programs

An often-overlooked danger in Clipper, FoxBASE, and similar applications that allow the VALID clause as part of a GET statement, is that pressing the PgDn key completes the READ. This bypasses and disables all subsequent VALID clauses. For example:

```
@ 1,0 GET firstname
@ 2,0 GET lastname VALID lastname>' '
@ 3,0 GET city VALID city>' '
@ 4,0 GET zip VALID zip>' '
READ
```

In the example above, you are appending new records using a series of GET statements followed by a READ. The program contains VALID clauses to make sure that the fields in each newly-entered record meet the necessary criteria for your file's integrity. (In this simplified example, the only requirement is that you not leave the field blank.) If you strike PgDn (or Ctrl-W) in the middle of the GETs, however, all subsequent VALID statements will be ignored. The new record is added to your database, but the error trapping has been defeated.

In Clipper, the solution is to disable both the PgDn and Ctrl-W keys (keys 3 and 23), using Clipper's unique SET KEY command. To do this, simply include the following in your procedure file:

```
PROC nothing
RETURN
```

Then, prior to entering the new record's data, issue the command

```
SET KEY <expN> TO nothing
```

Now when the program is running and you strike that key, "nothing" happens.—*N. E. Andersen; Fargo, North Dakota*

In normal use, of course, Clipper's unique SET KEY <expN> TO <procedure> command is used to DO something when that key is struck. (<expN> is the key's INKEY() value, a list of which can be found in the manual's Appendix G.) It's a creative trick to use this facility to "DO nothing."

Remember to reenable the keys after

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data entry with the command

    SET KEY <expN> TO

FoxBASE, which substitutes the more limited ON KEY command for Clipper's SET KEY TO, presents a more difficult problem. ON KEY allows only one key to be redefined. Thus, you can disarm PgDn with the command

    ON KEY=337 DO nothing

but this still leaves Ctrl-W in force. Hopefully, Fox will expand its ON KEY capabilities beyond a single key in future versions.—*Brad Stark*

Productivity Tip

Word-counting programs are useful, but they are not necessary with most word processors. To get a quick word count, set your margins to give 65 characters per line, count the number of lines, and multiply by ten. If necessary, get the number of lines by multiplying the number of pages by the number of lines per page. For normal text, the total will rarely be off by as much as 100 words.

Indexing on related fields lets you check, analyze, and report on dBASE III/IV data

In any relational database system, there are times when it would be useful to index a "parent" database on a field of its related offspring. Though the dBASE III documentation doesn't mention this as a possibility, you can do it.

Assume, for example, that you have a large parent database called SALES.DBF whose fields include Custid, Partit, Qty, and Date. Its offspring lookup file called CUST.DBF is indexed and (related) on the Custid field and includes the information on each customer. To obtain a list of customers and see what they've purchased, follow these steps:

    SELE B
    USE cust INDEX custid
    SELE A
    USE sales
    SET RELATION TO custid INTO B
    INDEX ON CUST->Name TO slsname

Now you will be able to display data on each customer directly from the transaction file.—*Alfonso Balzowski; San Ramon, California*

Mr. Balzowski's technique is extremely useful for reporting and analyzing any large transaction file that is related to a lookup file. Thus, for example, INDEXing on CUST->State will align all sales for a state-by-state report. INDEXing on CUST->slsmn will let you analyze how well each individual salesperson has performed.

Remember that Report .FRM files and Label .LBL files can also access fields in related lookup files. Suppose you have just used the Balzowski indexing technique with an .FRM to produce a printed report for each salesperson. Now you need a mailing label for each of them. You could accomplish this by creating a second index and adding the UNIQUE keyword: IN-DEX UNIQUE ON CUST->slsmn. A .LBL file will now produce a single label for each salesperson in the main database.

As a precaution, before generating a final output, I like to double-check that every record in the main database will find its match in the lookup file. Using the example above, I might issue the command

    COUNT FOR CUST->slsmn=" " TO bad

If the memory variable, bad, is greater than zero, something isn't lining up and needs to be fixed.

These techniques are equally useful in FoxBASE+, Clipper, or other dBASE clones that accept the SET RELATION TO command.—*Brad Stark*

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LANGUAGES

Redefining the function keys in GW-BASIC; avoiding a Turbo Pascal 4.0 problem with conditional compiling; counting words and lines in files under C.

A program in BASICA that accesses all interrupts

One of the many advantages of the new generation of BASIC compilers is their ability to call DOS and BIOS interrupts. Interrupts let programmers do a number of things that would be impossible using BASIC alone—determining the amount of free space that remains on a disk, for example. Unfortunately, BASICA and GW-BASIC do not provide this capability. I have written a general-purpose routine to overcome this problem and allow access to any of the system interrupts.

SYSINT (Figure 1 and Figure 2) is intended to be read from data statements and placed into a string variable. The string can easily be located using VARPTR and then called when needed. Like the QuickBASIC INT86 routine, SYSINT expects an incoming interrupt number and two integer arrays. One array contains the values to be

Figure 1: *An assembler routine to provide access to interrupts from BASICA.*

Figure 2: *A BASIC demonstration that obtains the free space on a disk.*

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placed into the processor's registers when the interrupt is invoked, and the other returns the register values when it has finished.—*Josh Mastronarde; South Windsor, Connecticut*

Most DOS interrupts do not require values to be specified for DS or ES, but SYSINT does provide that capability when needed. If DS or ES must *not* be altered, however, then assign a -1 to the appropriate REG.IN%() array element. This tells SYSINT that it is to use the current segment values rather than those contained in the array.—*Ethan Winer*

Opening the stdprn file pointer with Turbo C

The example program for "Redirect the Printer" (Languages, January 12, 1988) is helpful, but it is specific to Microsoft C and not at all ANSI compatible. The ANSI Standard defines only the standard FILE pointers stdin, stdout, and stderr. Some compilers (like Microsoft C) provide definitions for stdprn and stdaux, but Borland's Turbo C does not.

I have developed two different ways of defining stdprn with Turbo C (Figure 3 and Figure 4). These will work with other MS-DOS C compilers that do not already provide a definition for stdprn. The same technique can be used to define stdaux. —*George Defenbaugh; Tulsa, Oklahoma*

A question that occurred to me is if it can be done this easily, why didn't Borland go ahead and implement it? No matter, Mr. Defenbaugh found an easy way to open stdprn. Since the standard I/O file pointers are opened when a program begins, the example in Figure 3 simply declares stdprn as a pointer to FILE, and then opens it with a call to fopen(). Note that the filename is LPT1, just like you'd use it on the DOS command line, and that it is opened as a write-only text file.

The second example, shown in Figure 4, performs the same function, but it uses fdopen() to open the DOS file descriptor associated with the default printer. —*Richard Hale Shaw*

A simple way to count words and lines in files under C

It's often helpful to know how many words or lines are contained in a file. For instance, you can divide the line count for a file by the number of lines per page and determine how many pages are required to print the file. While the Unix operating system has a host of useful documentation-oriented commands, most of these are missing from DOS. WC.C (Figure 5) is modeled after its Unix counterpart that counts the number of lines and words in a text file. Since it accepts text from the standard input, the source code doesn't involve any file-handling overhead. It counts the number of words and lines in the text and prints the results on the standard output.

To use WC, enter

    WC < filename.txt

where filename.txt is the name of the file whose components you wish to count. —*Geoff Friesen; Dauphin, Manitoba, Canada*

```
/* create stdprn for Turbo C
 * version 1
 */
#include<stdio.h>

main()
{
        FILE    *stdprn;

        if(!(stdprn = fopen("LPT1","wt")))
        {
                fprintf(stderr,"\nUnable to open stdprn");
                exit(8);
        }
        fprintf(stdprn,"stdprn is open\f");
}
```

Figure 3: *This program listing declares stdprn as a pointer to FILE and opens it with a call to fopen().*

```
/* create stdprn for Turbo C
 * version 2
 */
#include<stdio.h>

main()
{
        FILE    *stdprn;

        if(!(stdprn = fdopen(4,"wt")))
        {
                fprintf(stderr,"\nUnable to open stdprn");
                exit(8);
        }
        fprintf(stdprn,"stdprn is open\f");
}
```

Figure 4: *This program uses fdopen() to open the DOS file descriptor associated with the default printer.*

```
/* WC.C a wordcount/linecount program
 */
#include <stdio.h>  /* header for getchar() */
#include <ctype.h>  /* header for isalpha() */
#ifndef  YES
#define  YES 1
#endif

#ifndef  NO
#define  NO  0
#endif

main()
{
    int character, wordcount, linecount, in_word = NO;

    wordcount = linecount = 0;
                                        /* get characters from standard input */
    while( (character = getchar()) != EOF)
    {
        if (character == '\n')      /* if it's a Newline       */
            ++linecount;            /* increment the line count */
        if (!isalpha(character))    /* if not an alpha character */
            in_word = NO;           /* set the in_word flag      */
        else if (in_word == NO)     /* else it's not alpha,      */
        {                           /* and was in a word         */
            in_word = YES;          /* reset in word flag, and   */
            ++wordcount;            /* increment the wordcount   */
        }
    }
                                    /* print the results */
    printf("      Number of words: %d\n", wordcount);
    printf("      Number of lines: %d\n", linecount);
}
```

Figure 5: *Demonstrating how easy filters are to use, WC also helps keep tabs on word and line counts.*

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Learning to write small utilities whose components can be used in more-complex programs is a key to becoming a master programmer. Filters are the building blocks for good C programs and the early versions of the many Unix system commands were simply filters like WC. To keep this filter small, compile it with Turbo C's tiny memory model, and create WC.COM. Take these steps (using the command-line version of Turbo C and ignoring the stack warning from the Linker):

```
TCC -mc WC
EXE2BIN WC.EXE WC.COM
```

—*Richard Hale Shaw*

Changing the function keys permanently in GW-BASIC

The function-key assignments built into the GW-BASIC interpreter provide a handy shortcut for entering often-used commands or text strings. However, most programmers have their own ideas about how these keys should be defined, and they inevitably end up running a small program to set them at the start of each session.

Changing the key assignments permanently is actually quite easy, using DEBUG to modify the GWBASIC.EXE file. The only slight complication is that DEBUG cannot be used on an .EXE file unless it is first renamed to have another extension. Also, because the function-key settings are near the end of the file, DEBUG's ES register must be modified. The following steps illustrate the procedure.

First, make a backup copy of your original GWBASIC.EXE file and put it away in a safe place. Then, rename your working copy of GWBASIC.EXE to BAS .BAK, and start DEBUG by entering DEBUG BAS.BAK. Next, display the ES register by typing RES <Enter> alone. This shows the current setting of ES and

then prompts for a new value. The new setting should be 1000h more than the previous one. That is, if RES showed 1234 you would enter 2234.

Next, display the registers by issuing the R command and note the contents of the CX register. Write this value down. The final step is to locate the table of key settings and make the necessary changes. To do this, use DEBUG's S command to search for the first string, which is LIST. Enter

```
S ES:0 L vvvv
```

where vvvv is the number that was contained in the CX register.

DEBUG will display both a segment and an offset, which can then be used with the E command to enter the changes permanently. Now enter

```
D <segment:offset> L 0A0
```

to display all of the key assignments, and

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then you should type the following

```
E <segment:offset>
```

to enter the changes for the appropriate keys.—*L. E. Reilly; Houston, Texas*

For each of the ten function-key assignments, memory has been reserved for up to 15 characters plus a terminating CHR$(0) byte. Because GW-BASIC uses a special marker to indicate where the string ends, it is possible to create commands longer than the usual limit of 15 characters. However, any characters beyond 15 will extend into the assignment for the next key. If that key is pressed, then only the trailing portion of the previous string will be used.—*Ethan Winer*

A problem with conditional compilation in Turbo Pascal 4.0 and how to avoid it

If you're trying to write code that will compile correctly under both Turbo Pascal 4.0 and Turbo Pascal 5.0, you can usually get around most of the differences by using conditional compilation directives—{$IFDEF Ver40}, {$IFDEF Ver50}, and so on. Unfortunately, there's one big stumbling block posed by Turbo Pascal 4.0. It generates an error when it sees an unknown compiler directive, even if it is in a block of code that won't be compiled. For example,

```
{$IFNDEF Ver40}
{$A-}
{$ENDIF}
```

would produce an error at the line containing the unknown Turbo Pascal 5.0 directive {$A-}.

The only way to get around this is to put the {$A-} in an include file, say AMINUS .INC, and change the {$A-} above to {$I AMINUS.INC}. (Interesting side note: Turbo Pascal 4.0 handles statements like {$IFOPT A+} correctly.)—*Brian Foley; Scotts Valley, California*

Conditional compilation makes it easy to generate and maintain different versions of your programs. The compiler itself supplies some conditional symbols—for example, Ver40 or Ver50 for Versions 4.0

and 5.0, CPU86 and MSDOS for all current versions, and CPU87 if an 80x87 math chip is present at compile time. You define your own symbols either by inserting a {$DEFINE symbol} in the program

● Conditional compiling makes it easy to generate and maintain different versions of programs.

code, by specifying the /D option on the TPC command line, or by selecting Options/Compiler/Conditional defines in the integrated environment.

Regardless of what kind of conditional symbol you use, Turbo Pascal 4.0 will stumble on an invalid compiler directive even if it's in a block of code that's not being compiled. Version 5.0 doesn't have this problem, fortunately.—*Neil J. Rubenking*

In Turbo Pascal, Versions 4.0 and 5.0, sometimes 0.0 is negative!

I have found that Turbo Pascal 4.0 has a bug in its floating-point routines when using the types DOUBLE and EXTENDED. When a number is made negative by subtracting, for example,

```
Y := -Y;
```

and the result just happens to be 0.0, Turbo Pascal 4.0 will print a negative sign in front of the 0.

To solve this problem I wrote a little routine that I call every time I write double or extended values.

```
IF Y = 0.0 THEN Y := 0.0;
```

By assigning Y to be 0.0, the variable is initialized to zero with the sign bit reset.—*K. F. Wong; Edmonton, Alberta, Canada*

This behavior seems odd, but it's exactly what's specified in the "Inside Turbo Pascal" chapter of the manual. In the descrip-

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tion of the Single, Double, and Extended types, you'll find a line that says

```
if e = 0 and f = 0, then v = (-1)s + 0.
```

That is to say, if the exponent is zero and the significand is zero, the number is plus or minus 0.0, depending on the sign bit. The definition for the Real type is quite different—in a 6-byte Real number, if the exponent is zero, the number is 0.0.

This won't affect your program logic, because in comparison tests zero and minus zero are equal. But it can be awkward to have your program display minus zero on the screen.

Turbo Pascal 5.0 users can see the difference between a variable that displays as 0.0 and one that displays as −0.0. Bring up the Evaluate window by pressing Ctrl-F4 and enter the variable name followed by ,m. The m format specifier causes the variable to be displayed as individual memory bytes. A 0.0 variable will show as all zeros, while the last byte of a −0.0 variable will be 80 hex because the sign bit is set.—*Neil J. Rubenking*

Productivity Tip

Some old PCs will crash if you invoke an uninitialized interrupt—for example, when checking for a mouse that hasn't been installed. One solution is to examine the interrupt vector in low memory first. Note that the 51 refers to interrupt 51h. For example,

```
Xor   AX,AX
Mov   ES,AX
Cmp   Word Ptr ES:[51*4],0
Je    NotInstalled
```

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PC TUTOR

Changing a program using DEBUG can be tricky; RECORDER lets you optimize RAMdisk usage; gaining a more versatile AUTOEXEC.BAT file with a special batch utility.

Optimizations and tradeoffs when using LIM and extended memory

Could you advise me how best to set up memory on my Zenith Z-248 Advanced PC (an AT compatible) for a wide variety of software? Some programs, such as *WordPerfect* 5.0, can use LIM expanded memory but are not recommended for use with a RAMdrive. Others, such as *Word-Perfect Library* 2.0, can use either expanded memory or a RAMdrive.

I've got 1.5MB of LIM and would like to set up my AUTOEXEC.BAT file to cover most situations and programs. What are the advantages and disadvantages of using and mixing BUFFERS, FAST-OPEN, VDISK, caching software, and LIM memory? Would your answer be different for a computer with 2.1MB of extended memory and no LIM memory?
—*Craig L. Carver; Barstow, California*

It's easy to see why you're confused. There are a lot of options in configuring a PC and no clear-cut rules for doing so. I'll present a few basic guidelines that should help you.

Keeping the most recently used disk data in an area of memory known as a buffer can speed up apparent disk performance. This is because many program operations access the same area of the disk repeatedly. By first checking the buffer for the requested data, an unnecessary disk read can be avoided. The DOS BUFFERS statement (in your CONFIG.SYS file) tells DOS how many buffers to allocate when

you boot your computer. If you specify too few buffers, program performance will suffer. Specify too many buffers, however, and the time spent searching them all can add up to more than the time it would take to read from the disk. A good compromise is BUFFERS=20.

A disk cache program is a very smart form of buffer. It performs basically the same service: keeping recently used disk data in memory for faster accesses. A disk cache executes faster when using expanded memory on a LIM memory board than when using extended memory (as IBM-CACHE does), but any cache is better than none. Unlike with buffers, using a larger disk cache will always improve performance. If you have the memory, allocate 1MB for a cache. When using a disk cache program, searching the DOS buffers actually slows you down, so set BUF-FERS=3.

A typical RAMdisk can speed up disk

■ *While all computers can accept expanded (LIM) memory, only computers with an 80286 or 80386 CPU can have extended memory.*

operations by a factor of 100 and greatly increase program performance. This is especially true for large application programs that use overlays that must be loaded and reloaded from disk. Some programs, however, can use LIM memory directly to store their overlays.
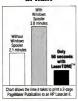
Assume that all LIM memory is used to create a RAMdisk that will hold the entire *WordPerfect* program file, WP.EXE. When the program is executed, it will load and access overlays from the RAMdisk very quickly. But since enough LIM existed to hold the entire WP.EXE file on the RAMdisk, if the RAMdisk had not occupied the LIM memory, the WP.EXE program would have simply loaded in its entirety. Accessing overlays directly in LIM is faster than loading them from a LIM RAMdisk. So, if you have a small amount of LIM, it is better to let programs use it directly than it is to create a RAMdisk.

While all computers can accept expanded (LIM) memory, only computers with an 80286 or 80386 CPU can have extended memory. Under DOS, this type of memory can be used by a RAMdisk (such as VDISK) and a disk cache (such as IBM-CACHE). If you have only extended memory, it would be better used for disk caching.

Nine RAM chips are used to store 8 bits of data and 1 bit of parity

Recently, when adding RAM chips to my computer, I noticed that each bank contains 9 sockets for 64-kilobit chips. Since

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each chip contributes 1 bit for every byte in 64K of bytes, 8 chips would seem sufficient. What is the ninth chip for?—*Michael Matthews; Trumbull, Connecticut*

You're correct. Only 8 chips are needed to contain the 8 bits that make up a byte. The ninth chip is used to store an extra bit, called the parity bit, for each byte. The parity bit is used by the memory hardware to perform a parity check, which is a crude check of memory integrity.

Parity is set when writing data to memory. The hardware counts the number of 1s in the byte and sets the parity bit to either 0 or 1 to make the total number of 1s even. This is known as even parity. (Odd parity would set the parity bit to make the total number of 1s odd.) When the data is read from memory, the parity is recalculated and compared with the stored value. If it's not the same, a parity error is generated, and the computer is halted.

For an additional, more-in-depth discussion of parity checking and memory, see the July 1988 PC Lab Notes "Instant Speedup for Your PC."

Changing a memory-resident program's hotkey is not simple

I use a lot of memory-resident utility programs. Often, the hotkey of one program will conflict with anothers. If I have a firm knowledge of assembly code and no access to the source code of the program, is it possible to use DEBUG to search for and change the hotkey?—*Ray Stroud; Oklahoma City, Oklahoma*

Changing a program using DEBUG is a tricky process. It takes a thorough knowledge of exactly what the program is doing. And if you don't know where to make the changes, the procedure becomes a little like looking for a needle in a haystack. It's impractical to give a step-by-step procedure, since every case is different. But, if you are not the type that is easily intimidated, here are the general guidelines you will need.

First, you should load the memory-resident program. Then, using DEBUG, search for the vector for interrupt 9 (the keyboard interrupt) is pointing. Chances are it

will be pointing to the newly loaded program. Then start to examine the instructions at that memory location until you see the program access the keyboard I/O port and check for a keyboard scan code. Then patch it!

Depending on the way the program is written, this process can take anywhere from 5 minutes to all night. Remember to keep a copy of the original program in case you make a mistake.

Optimizing RAMdisk usage is a snap using the *PC Magazine* utility RECORDER

I try to run applications from a RAMdisk to speed up my work and reduce wear and tear on my hard disk. Because I run so many applications, it's difficult to know which of the many files are actually used by each program. I do know that not all of them will fit on my RAMdisk.

It would be useful to have a program that logs files as they are called by various application programs. Do you know if one is available? If not, it would be good to print one in your Utilities column.—*Edward A. Wolff; Silver Spring, Maryland*

You're in luck. Our free utility, RE-CORDER, featured in the May 17, 1988, issue of PC Magazine, does exactly what you need. RECORDER keeps track of all file read and write operations. This information not only tells you what files are being used, but how much activity is taking place.

Like all of the programs in *PC Magazine,* RECORDER can be downloaded from PC MagNet, our on-line information service. To join PC Magnet, see the "By Modem" sidebar in this issue's Productivity section, next to the DOS command page.

The letter-counting program, FREQ.ASM, was the right answer but the wrong format

Thank you very much for publishing the program FREQ.ASM in response to my request (PC Tutor, December 27, 1988). I don't, however, have a macro assembler.

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```
100 REM - BASIC PROGRAM TO CREATE FREQ.COM
110 CLS:PRINT "Creating FREQ.COM         "; OPEN "FREQ.COM"  AS #1 LEN = 1
120 FIELD #1, 1 AS A$: CHECKSUM#=0
130 FOR J = 1 TO   16
140 LINESUM#=0: LOCATE 2,31 PRINT "Countdown: "   16 - J
150 FOR J = 5 TO 16: READ BYTE$: BYTE = VAL("&H"+BYTE$)
160 CHECKSUM = CHECKSUM# + BYTE: LINESUM# = LINESUM# + BYTE
170 IF (BYTE < 256) THEN LSET A$=CHR$(BYTE): PUT #1
180 NEXT J
190 READ LINETOT$: LINECHECK# = VAL("&H"+LINETOT$)
200 IF LINECHECK# = LINESUM# THEN GOTO 220
210 LOCATE 4,2: PRINT "Error in line #" ;  268 + 10 * J: GOTO 260
220 NEXT J
240 CLOSE: READ FILETOT$ : FILECHECK# = VAL(FILETOT$)
250 IF CHECKSUM# <> FILECHECK# THEN GOTO 268
260 PRINT: PRINT "FREQ.COM     created successfully!" END
270 PRINT: PRINT "FREQ.COM     is not valid!": END
280 DATA 68, 7B, 20, 46, 52, 45, 51, 2E, 31, 2E, 2E, 38, 28, 31, 39, 38, 38, 4C0
290 DATA 20, 63, 29, 2E, 5A, 65, 65, 20, 49, 4F, 60, 60, 75, 68; 512
300 DATA 63, 61, 74, 69, 6F, 6E, 73, 2E, 49, 6E, 2E, 2E, 5A, 59A
310 DATA 2E, 46, 61, 72; 41, 47, 41, 7A, 69, 6E, 2E, FE, 2E, 52, 4F, 42, 45, 412
320 DATA 72, 74, 2E, 4C, 2E, 2E, 48, 75, 6D, 60, 65, 6C, 6C, 2A, 2A, 1B, 450
330 DATA 2A, 74, 65, 61, 67, 65, 3A, 2E, 62, 52, 45, 51, 2E, 74, 65, 78, 74, 562
340 DATA 2A, 8, 8, 8, 8, 8, 8, 8, 8, 8, 8, 8, 8, 8, 8A, 1; 1
350 DATA B4, 9, CD, 21, 32, E0, 6A, E, 8F, 8, A, C9, 75, C, BA, 50; 640
360 DATA 1, B4, 9, CD, 21, B8, 1, 4C, CD, 21, BE, 81, 8, 32, FF, AC; 6A8
370 DATA C, 2C, 61, 3C, 19, 77, F, 8A, D8, FE, 87, 61, 1, E2, EF; 6A7
380 DATA B2, 63, 1, 89, 1A, 9, 32, DB, B4, 2, B2, C, CD, 21, B4, 2; 63A
390 DATA B2, A, CD, 21, FA, BA, FE, C3, 88, C2, 41, B4, 2, CD, 21, B4; 8A3
400 DATA 2, B2, 20, CD, 21, AC, BB, 7, 8, E2, D0, B8, 8, 4C, CD, 21; 7BE
410 DATA 32, E4, D4, A, D, 38, D0, 5B, D0, D4, B4, 2, CD, 21, 5B, 8A, 695
420 DATA D8, D4, 8, 84, 2, CD, 21, C3, B, 8, 9, 8, B, 8; 337
430 DATA 21223
```

Figure 1: *This BASIC listing will create FREQ.COM when you run it once.*

Could you publish it as a BASIC program or DEBUG script?—*Stephen A. Smith; Pasadena, Maryland*

Sorry about that! Normally, I do provide either a BASIC program or a DEBUG script that creates an executable version of my programs for those of you who do not have an assembler. In this case, however, it seems I overlooked it. The listing in Figure 1 is the BASIC program, FREQ.BAS, that will create FREQ.COM when it is run once.

Use special batch utilities to make your AUTOEXEC.BAT file more versatile

In the November 29, 1988, issue of *PC Magazine*, you published CONFIG.CTL, a utility that lets me change my CON-FIG.SYS file before I boot up my computer. I installed the program without any problems, but now I find that the RAM-disk I deleted is still expected by my AU-TOEXEC.BAT file. Is there a program for controlling my AUTOEXEC.BAT file the same way CONFIG.CTL controls CONFIG.SYS?—*Tom Cutter; Portland, Oregon*

Unfortunately, there is no utility currently in existence that will allow you to edit your AUTOEXEC.BAT file when you boot up your computer. However, it's usually possible to embed enough intelligence into a batch file to allow it to make the process automatic.

The PC Tutor program, CHK-DRV.COM, was featured in *PC Magazine* February 28, 1989, allows a batch file to test for some common disk-error conditions. In your case, you can use it to check for the existence of the RAMdisk, then execute the appropriate set of instructions.

Ask the PC Tutor

The PC Tutor solves practical problems, explains points of general interest about using your hardware and software more productively, and answers basic questions about DOS and systems in general. To see your questions answered here, drop a line to PC Tutor, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (to join, see the "By Modem" section in the Productivity section). We're sorry, but we cannot answer questions personally. ▨

■ FRANK J. DERFLER, JR.

CONNECTIVITY CLINIC

Different computers can share the same language with TCP/IP software from the right companies; an easier way to send messages through NetBIOS.

A simple system for sending messages through NetBIOS

You recently printed a NetBIOS utility with two programs, IMPORT and EXPORT (Connectivity Clinic, January 17 and 31, 1989), that transfer files across nodes in a network using the transport services of NetBIOS. Here are two programs that provide a simple system for sending messages, instead of files, through NetBIOS.

NETRCV and NETSND don't store and forward messages, but they will use the NetBIOS naming services to let you send messages to a specific station, a group of stations, or to all stations on the network. And although they can't substitute for a full e-mail service, many people will find them useful.—*Jack Schoof, Tucson, Arizona*

The NETSND program can transmit a message of up to 128 bytes long, entered at the command line. The first 8 bytes (or less) must be the name of the receiving party. If you want to send a message to everyone, use the wildcard asterisk as a destination name.

Machines running the NETRCV program will intercept all NetBIOS datagrams and try to match the destination name with the internal name set into NetBIOS by NETRCV. The code for extracting the name from the NetBIOS datagram and matching it with the internal name is in Figure 1. Since NetBIOS is fairly primitive, it is up to the programmer to account

for quirks such as DOS changing "*" to "?" in the file control block and for the possibility that people will use upper- and lowercase letters indiscriminately.

Other application program interfaces, such as Named Pipes found in Microsoft's *LANManager* operating system, handle these quirks and features automati-

cally. These higher-level APIs make it easier for someone to write an application with less code than NetBIOS requires. On the other hand, once you have a sequence like the one shown in Figure 1, you can quickly call it from a library and use it with great precision.

The last part of the code in Figure 1 de-

```
                MOV AX,SEG NAIS_DATA                  ;POINT TO OUR DATA
                MOV DS,AX                              ;GET THE LENGTH OF THE RECEIVE
                MOV CX,RMCS.NCB_LENGTH                 ;POINT TO THE RECEIVE BUFFER
                MOV SI,OFFSET RCV_BUFFER               ;AND THE MATCH NAME
                MOV DI,OFFSET MATCH_NAME
NXTCM:  LODSB                                          ;GET DS:SI INTO AL
                MOV AL,[DI]                            ;HAVE WE HIT A STAR?
                CMP AL,'*'                             ;YES THEN WE MATCHED
                JS MATCHED                             ;DO THEY CHECK OUR INTERNAL NAME
                CMP AL,[DI]                            ;A QUESTION MARK ON THE RECEIVER?
                CMP AL,'?'                             ;DOS CHANGES * TO QUESTION MARKS IN FCB
                JS MATCHED                             ;CONVERT TO LOWER CASE
                CMP AL,'a'                             ;THAN AN 'a'
                JC SOTLC
                CMP AL,'z'+1                           ;GREATER THAN A 'z'
                JNC SOTLC                              ;SUBTRACT THE RIGHT AMOUNT TO MAKE UC
                SUB AL,'a'-'A'                         ;ARE THEY NOW BOTH THE SAME?
SOTLC:          CMP AL,AL                              ;NO THEN REJECT THE RECEIVE
                JNZ REJECT                             ;IF THEY ARE BOTH SPACES THEN WE
                JS MATCHED                             ;MATCHED
                INC DI                                 ;UPDATE THE DI POINTER
                LOOP NXTCM                             ;AND KEEP GOING
MATCHED:
                CALL OUTCR
                MOV AL,' '                             
                CALL OUTCH
                MOV AL,' '                             
                CALL OUTCH
                MOV AL,';'                             ;DISPLAY THE ";; "
                CALL OUTCH
                MOV SI,OFFSET RMCS.NCB_CALLNAME+15     ;POINT TO WHO SENT THE MESSAGE
                MOV CX,8                               ;6 END DIGITS ARE ADAPTER ADDRESS
ADPTO:  LODSB                                          
                PUSH CX                                ;DISPLAY THE DIGITS
                CALL HEX2                               
                POP CX                                 
                LOOP ADPTO                             ;UNTIL ALL DONE
                MOV AL,';'                             
                CALL OUTCH
                MOV AL,' '                             
                CALL OUTCH
                MOV AL,' '                             
                CALL OUTCH                             ;DISPLAY THE "; "
```

Figure 1: *This code is extracted from a larger program, called NETRCV, that moves messages between network nodes using NetBIOS. This section illustrates how the program looks for datagrams containing a match for the specified destination name.*

rives the network adapter card identification of the sending station. You can write other NetBIOS utilities, such as security and e-mail programs, that use this information.

The full listings for NETRCV and NETSND are too long to publish here. However, you can download the source code and .EXE files by modem from PC MagNet. See the "By Modem" sidebar in the Productivity section of this issue for instructions.

TCP/IP software from the right companies lets different computers share the same language

Our company has a hodgepodge of computers. We have DEC VAX minicomputers with terminals, Wang VS minicomputers with terminals, lots of standalone PC clones of various types, and two small No-

vell LANs using Ethernet hardware and Novell software. Since we seem to reorganize our operation every 3 months, I know that sooner or later, users are going to want to hook these things together. What should I be planning to do? Is there some "magic box" that interprets all these systems?—*Bill Walsh; Sherbrooke, Quebec, Canada*

You have to attack the problem of how to connect different kinds of computers by looking at the different levels of connection. At each level, you have to look for hardware or software that the different pieces of your system have in common. You have a good start with Ethernet. Both DEC and Wang have Ethernet network interface cards and driver software for their computers.

But having a common Ethernet connection only means that you can move packets between the computers—it doesn't mean

the computers know what to do with the data when it arrives. Sometimes you can find a complete network transport and file service package that will work on all your machines. For example, there are versions of *NetWare* for VMS and DOS; there are TOPS packages for DOS, Unix, and Apple operating systems; and there are *LAN-Manager* versions for VMS and DOS. You could make a mixe mixed network of PCs and DEC VAX minicomputers and share files and peripherals under either *NetWare* or *LANManager*. But I don't know of any easy solution like this that includes Wang systems.

You are going to have to take a half step and find a way to bring data up to the level of the operating system where application programs can find it. The best universal solution is to use the transmission control protocols and internet protocols developed by the Federal Government.

The TCP/IP protocols handle the trans-

■ CONNECTIVITY CLINIC

mission of packets across a network and between networks. After TCP brings the data package into a computer, other higher-level programs can handle it. Some of these higher-level programs are also standardized, like the File Transfer Protocol (MIL-STD-1780) and the Simple Mail Transfer Protocol (MIL-STD-1781). If you use these standard protocols on different kinds of computers, you will at least have ways of easily transferring files and other kinds of data.

The trick is that you usually have to get the TCP/IP and other standard protocols from the companies that market each specific computer and operating system. In this case, both DEC and Wang generally support TCP/IP. But you'll have to check with them to see if their support extends to the specific hardware and operating systems you use. Make sure the TCP/IP modules you buy meet the referenced military standard.

Some companies like CMC and Excelan provide TCP/IP modules for popular computer systems. There are several ways to implement TCP/IP on Novell *NetWare* LANs. I like the *NetWare* solution provided by the Wollongong Group because it is flexible and doesn't load each workstation.

TCP/IP isn't magic. There are a lot of details about implementing TCP/IP that you have to get exactly right. But TCP/IP is the most widely available, standardized way to link dissimilar computers right now. Over the next couple of years, similar protocols following standards set under the Open Systems Interconnection model will emerge, but for now, TCP/IP is the best bet.

For more information contact:

■ CMC, 125 Cremona Dr., Santa Barbara, CA 93117; (805) 968-4262

■ Excelan, 2180 Fortune Dr., San Jose, CA 95131; (408) 434-2300

■ The Wollongong Group, 1127 San Antonio Rd., Palo Alto, CA 94303; (415) 962-7100.

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Connectivity Clinic gives you practical solutions to networking problems of all types. We'll pay $50 or more for any tips we print, *plus an extra $25 if you submit your letter on-disk*. Please include a printed copy. We'll gladly answer your questions at no charge, but we cannot answer letters personally. Mail contributions to Connectivity Clinic, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (to join, see the "By Modem" sidebar in the Productivity section). You may also contact Frank J. Derfler, Jr., via MCI Mail (see Derfler's box named CONNECTIVITY CLINIC). 圖

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  20MB fully installed or upgrade to a higher capacity drive.
- **Printer**
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  - 180cps draft, 30cps near letter quality
  - Multiple type styles
  - Tractor/friction paper feed
- **Software**
  - CompuAdd INTEGRATOR Program/file managers, cardfile database, calendar, calculator, text editor, and PC-FullTalk
  - CompuAdd MS-DOS and GW BASIC
- **Accessories**
  - 200 sheets of continuous form paper
  - Printer cable and ten blank floppies

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40MB	$1715	$2065	$2265

Career Starter Kit

- **Computer:**
  CompuAdd Turbo/10
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  - 5.25" 360KB floppy drive
  - Floppy drive controller
  - Eight expansion slots
  - Math coprocessor support
  - Choice of AT-style, 5151, or enhanced 101-key keyboard
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PC MAGAZINE

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Don't send cash, you will have no record of payment if a problem arises; and;

Keep a copy of your order and all other correspondence with the Seller. Your records should include the company's name, address and phone number; a description of the item ordered; your canceled check or a copy of the money order; record of the date you mailed the order, or the time and date of your conversation, and the name of the person you talk with; and any sales slips and shipping receipts.

Ask about servicing and refund/return policies and with whom you should correspond if there is a problem.

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PC MAGAZINE MARKETPLACE

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AFTER HOURS

Inveterate ski bums and wobbly-kneed novices alike will find that *World->File Ski* ($14.95 from World Associates in Travel) organizes all the details that go into planning a skiing vacation. Specify what you want; heli-skiing, skating, kiddie stuff, whatever, and *World ->File* will search its database to find and display matches.

The information is presented in two main menus, one for the major ski areas in the United States and Canada, and another that comprehensively covers

World->File Ski's database has a wealth of data about ski resorts; this information is the package's most useful feature.

Europe and South America.

For the most part, it's easy to find the information for the trip of your dreams because *World ->File* makes the user feel at ease from the start. The opening menu gives you three choices: tour packages, tour operators, and resort information.

The tour package submenu is good for the traveler who would rather not have to deal with all the little details that make trip planning so tedious. Hotel and flight information are

presented legibly; it's just a matter of telling *World->File* where and when you want to go.

The tour operator submenu lists operators who subscribe to *World->File*. This clumsy menu supplies information that is readily available elsewhere in the package; its usefulness is questionable.

The resort information submenu is great for getting general information on an area. In fact, it's the heart of the package. This is where *World->File* demonstrates how much research has gone into it. Those who don't frequent Innsbruck or Chamonix regularly will appreciate the effort.

Cross-country skiers may find less to cheer about than their downhill brethren. Many major ski areas have access to or are affiliated with skinny-ski facilities; the selection offered by *World->File* is limited to these.

World->File is useful, helpful, and for the Alpine skier, very complete. If you want to take a lesson, bomb mogul fields, or sit on the sun deck during the day, look here.

List Price: *World->File Ski*, $14.95. **Requires:** 256K RAM, DOS 2.0 or later. Not copy protected. World Associates in Travel Inc., 29 Birch Brook Rd., Bronxville, NY 10708; (800) 624-5659, (914) 793-7310.

CIRCLE 546 ON READER SERVICE CARD

Ultima V: Warriors of Destiny features much-improved graphics to go with the dense story line and numerous characters the game offers.

![GAMES]

Combat Hate, Fear, And Lies in The Treacherous World of Ultima V

BY STEFAN PETRUCHA AND HY BENDER

Origin Systems' Ultima series has long set the standard for PC fantasy adventure. Its latest entry, *Ultima V: Warriors of Destiny* ($59.95) continues the tradition of excellence—it's the best yet.

The game begins with the king, Lord British, lost beneath the earth. In his place, the ambitious Blackthorn rules, under the influence of three insidious Shadowlords of Hate, Fear, and Lies. A clandestine Resistance is countered by an evil Oppression. In the midst of this, the legendary Avatar (that's you) is summoned to destroy the Shadowlords and then free the king.

During play, you join the Resistance, infiltrate the Oppression, escape torture chambers, sail the high seas, translate runes, meditate in holy shrines, climb mountains, ride down waterfalls, and even learn to play the harpsichord.

You also meet hundreds of minor characters who help flesh

out the action. These people react and speak in natural and delightfully surprising ways. They even follow individual schedules, eating, sleeping, and working independently of your adventure.

In *Ultima V* the graphics finally come of age; previous versions had been visually disappointing. The game offers such delights as charging monsters gnashing their teeth and spells shimmering across the battlefield.

Another major improvement is the combat system. For the first time, strategy plays a major role turning the standard hack-and-slash encounter into more of a chess match.

The program isn't perfect. The sound effects, amusing at first, quickly become annoying. Also, the game runs very slowly on a standard PC, requiring a lot of patience. And, in the tradition of the whole *Ultima* series, the ending is somewhat lacking.

These defects barely mar the game's high quality, though. *Ultima V* is the best of a superior lot. If you're at all interested in role-playing games, buy it. ![PC]

List Price: *Ultima V: Warriors of Destiny*, $59.95. **Requires:** 256K RAM, graphics adapter, DOS 2.1. Copy protected. Origin Systems Inc., 136 Harvey Rd., Londonderry, NH 03053; (603) 644-3360.

CIRCLE 547 ON READER SERVICE CARD

![PC] ADVERTISERS PRODUCT INDEX

RELIGION

Digital Scripture: Chapter and Verse on Your Hard Disk

BY DON TRIVETTE

"Canst thou by searching find out God? [Job 11:7]" *Bible Quest* and *WORDsearch* think so. These two programs put the entire Old and New Testaments—all 780,000 words—on your hard disk and provide search software so you can find any passage faster than you can say Methegammah.

WORDsearch

WORDsearch, the $139.95 product of WORDworks Software Architects, relies on function keys to select commands. F1, for example, always pops up a context-sensitive help screen; F2 creates and names a reference list, necessary for performing a search. Once the reference list is named, you may find passages using either the Verse/Range or the Word/Phrase command. The first method involves the straightforward entering of book, chapter, and verse; the second method uses text search techniques to locate the desired passages.

Word/Phrase searches may be modified by the Add, Remove, Keep Only, and Clear commands. Instead of Boolean operators, the program uses Remove and Keep Only to refine and modify a search. To locate all the verses that contain both the word *bread* and the word *water*, for example, you enter "bread" and then use the Keep Only command with "water."

The developer claims this is as easily understood as the more computerese *and, not,* and *or* logical operators. Entering "bread and water" on the search line causes the program to find all occurrences of that specific phrase. The search engine also supports "??" as

Both WORDsearch and Bible Quest allow you to search the scriptures for occurrences of a specific word.

wildcard; thus, "lov*" finds *love, loving, loved,* and *lover,* to name a few.

WORDsearch has the ability to access multiple versions of the Bible. Although the program can't display passages from two versions on the same screen, the second version is just two keystrokes away. The program can be purchased in either the King James Version (minus marginal notes and Apocrypha) or the New International Version—or both for $60 more.

Comparing the old with the new is fascinating. Look up Matthew 7:6 in the King James Version and you'll find the familiar passage about casting pearls before swine; check the NIV and you'll see a reference to throwing your pearls to the pigs.

WORDsearch has an abundance of other goodies, including the ability to append (and save) your own notes to verses—perhaps an important feature for serious students of the Bible.

Bible Quest

InfoQuest Technologies' $99 *Bible Quest*—likewise based on the King James Version—has a note-taking option, but it has the other features you'll want for simple Old and New Testament searches. For instance, selecting Find from the Point and Shoot menu pops up a query

window that presents the option of searching by word or by book/chapter/verse.

Bible Quest uses the conventional Boolean search terms *and, not,* and *or* to locate a passage. Thus, entering "bread and water" produces references to verses that contain both the word *bread* and the word *water*. The F6 key acts as a switch that lets you find specific phrases like "bread and water."

The wildcard feature is more sophisticated than the one in *WORDsearch*. In fact, it's identical to DOS's DIR wildcard format. The question mark represents a letter, and the asterisk stands for a sequence of letters. Thus, "B?D" generates a list of references to verses containing *bad, bed,* and *bid*.

When you type a search

word, *Bible Quest* automatically pops up a word-list window containing words of similar spelling. This is a handy feature when you're not sure how to spell something; Methuselah, for example, comes between Methegammah and Meunim. *Bible Quest's* help feature is a list of topics rather than a true context-sensitive aid, but that presents little problem since the program is very logically constructed.

Both programs are fast and accurate, and both require about 2.3MB on your hard disk for program and data. Both can show the searched-for text in context. *Bible Quest* is slightly easier to use than *WORDsearch*, although it lacks a notetaking feature. Either program can be used to test the proposition of Job 11:7, but I don't think I'd pay 40 percent more for *WORDsearch*.

List Price: *WORDsearch*, $139.95. Requires: 256K memory, hard disk, DOS 2.0. Not copy protected. WORDworks Software Architects, 5014 Lakeview Dr., Austin, TX 78732; (800) 888-9898.

CIRCLE 545 ON READER SERVICE CARD

List Price: *Bible Quest*, $99. Requires: 640K memory, hard disk, DOS 2.1. Not copy protected. InfoQuest Technologies Inc., 1681 West 820 North, Provo, UT 84601; (800) 336-6644.

CIRCLE 544 ON READER SERVICE CARD

Unlike WORDsearch, Bible Quest uses conventional Boolean operators to construct search parameters. Specifying "bread and water" finds verses that contain both words.

AFTER HOURS

Micro Music Manager Catalogs Classical Record Collections

BY GLEN BECKER

Any database management system helps you organize a *collection* of records. Here's one that organizes a classical *record collection.*

In Micro Music Manager, *each screen is a ready reference to a recorded selection. Sometimes, however, there is not enough room to list the entire ensemble.*

lection. For musicians, critics, radio personnel, and other serious collectors, *Micro Music Manager, Opus 2* is a dream come true. Almost.

The system is beautifully simple. You type each recorded selection's vital statistics into a template with 13 fill-in-the-blank fields. If you own three recordings of the same Bach sonata, you create a separate database record for each one. Editing, searching, and printing the data are ultra-easy (a small sample database is included).

The size of your database is limited only by hard disk capacity. A 20MB disk holds up to 17,000 titles—which your PC can search, facilitating questions like "How many recordings of Beethoven's Opus 131 do I own? And which symphonies conducted by Weingartner? What's the format of each one: 78 RPM record, open-reel tape, compact disk? Where is it

stored?" You can even set up separate databases for classics and jazz.

The package's simplicity is also its weakness. A fixed-length 40-character field is needlessly long for the conductor's name but could be too short for the music's full title. With the selection and album number entered, the "album title" field is seldom useful.

Although the program gives you an "other" field—and lets

you attach a few lines of "notes" to all instances of a given entry—it will frustrate the conscientious cataloger who wants his database to contain fuller information than is found on a record's front cover.

To be thorough, we need fields for additional composers (up to five for one ballet), arranger or editor, composition date, recording date, pages included (for "excerpts" albums), measures excluded, section timings, and critical comments. Below the title of a lieder cycle, add fields to identify the song, text author, key, and language used. And for opera, add a list of singers, linked with their voice types and roles.

Beware of inconsistent input: the software will never recognize that "Royal Philharmonic," "The Royal Philharmonic," and "RPO" are the same orchestra. Better maintain a paper style sheet, listing all

your spellings and conventions. (Why isn't there a "crib sheet" file the program could access?)

Micro Music Manager is an attractive package, with a 60-day money-back guarantee. But this version won't accept the questions I want to ask: Find me the 1917 version of *Verklärte Nacht.* List all records where the composer is also the conductor. Then print out all Italian-language pre-1950 excerpts from *Carmen*—in correct sequence as heard in the score.

If you don't need that level of detail and you simply want a computer index of your Mozart and Mahler, *Micro Music Manager* is the next best thing to a private librarian.

List Price: *Micro Music Manager, Opus 2,* $65. Requires: 256K RAM, hard disk, DOS 2.0 or later. Not copy protected. M³ Software Co., P.O. Box 27638, Austin, TX 78755; (512) 346-2820.

CIRCLE 542 ON READER SERVICE CARD

The Entertainer: Familiar Tunes For Your Basic Routines

BY JONATHAN MATZKIN

You've heard of clip art? Well, *The Entertainer,* from PDI, is clip *music.* It's a library of whimsical little songs and sound effects, written in BASIC, that you can play back through your PC's speaker, with no additional sound equipment necessary.

You can include musical selections from *The Entertainer* in your BASIC programs in much the same way that you might spruce up desktop publishing output with clip art. The $79 price includes a royalty-free license to distribute *Entertainer* sounds in your code.

Among *The Entertainer's* 270 prewritten selections are

standards, folk tunes, work songs, and a variety of other familiar melodies. You will also find sounds associated with video games and entertainment software, including a ray gun, a siren, and a ticking time bomb. If you prefer to program your own music, you can refer to *The Entertainer's* facility written manual, which contains a tutorial that teaches BASIC music programming.

The Entertainer is intended mostly for developers, but you don't have to be a programmer to play back the sounds. You load *The Entertainer's* playback program under BASIC and then select a tune from simple menus. Music you have programmed yourself can be accessed through *The Entertainer's* playback facility.

As a song is playing, *The Entertainer's* playback program displays an informative text screen. The information varies in its interest level; the only information supplied about "My Wild Irish Rose" is the composer's name, his dates of birth and death, and the copyright date of the song. "On Top of Old Smokey" is accompanied by a few words about its origins in the great push westward.

Since the sounds *The Entertainer* generates are played through the PC's meager little speaker, the sound quality and tonal range are far from breathtaking. Anyone expecting a polyphonic synthesizer will be disappointed. But the vast majority of PCs have no MIDI support, so that tinny speaker is the only game in town.

The Entertainer is probably worth its $79 price for developers who want prewritten sounds for their code. Whether it's worth the price as a novelty is your call.

List Price: *The Entertainer,* $79. Requires: 192K RAM, BASIC 2.0 or later, DOS 2.0 or later. Not copy protected. PDI, P.O. Box 18655, Boulder, CO 80308; (800) 727-4140.

CIRCLE 543 ON READER SERVICE CARD

MUSIC

MusicPrinter Plus Offers WYSIWYG Music Notation, MIDI Playback

BY RICK BASSETT

Computers have a hard time with musical notation. How does your PC know that what you just wrote is a musical innovation rather than a mistake? Unfortunately, most music notation programs are somewhat narrow and place too many limitations on music use. Other software is too cumbersome and tries to anticipate every musical possibility.

MusicPrinter Plus, Version 2.0, manages to remain simple to use while allowing your music to get very complex. Beyond helping you with notation, it also reads your score and performs it on synthesizers

equipped to support MIDI, the Musical Instrument Digital Interface protocol.

You enter a musical score into MusicPrinter Plus much as you would write it on paper. To enter notes and symbols, you move the cursor around the screen in a "what-you-see-is-what-you-get" environment. Symbols are easily chosen by hitting mnemonic keys, such as *q* for quarter note. You can enter notes in any order, jump from staff to staff, and insert or delete at any time. Moving around the screen is easy, especially with a mouse. The keys of a MIDI keyboard also can be used to position the cursor vertically on the staff.

Unlike some music-printing programs, MusicPrinter Plus does no automatic formatting of the score. It is up to you to make sure your music lines up properly, but you have the freedom to put the notes exactly where you want them. Fortunately, inserting and deleting space is no problem, even in the middle of groups of beamed notes; it is also easy to copy, move, overlay, or transpose blocks of music. Once a score is finished, you can easily extract single instrument parts and edit them separately.

MusicPrinter Plus provides several text fonts, characters to make guitar chord diagrams, jazz chord symbols, percussion symbols, beams for nonduple rhythms, and many contemporary music symbols. While it would be nice to have a means to draw your own symbols, this assortment should cover most situations.

Scores printed on a dot ma-

MusicPrinter Plus creates very readable notation out of inexpensive printers. This output sample was generated by an Epson-compatible 9-pin dot matrix printer.

trix printer look very clean and are easy to read. Canon Bubble-Jet printers yield even better results, though there is still some graininess. Since MusicPrinter Plus does not support laser printers, its scores are not really "publishing quality." Nevertheless, they are fine for many professional purposes and educators or hobbyists.

MIDI Performance

The program's performance of scores via synthesizers is a special strength. To perform your score via MIDI, you must follow certain rules, but most of them conform to standard notation practice. MIDI channels, patch changes, response to dynamic markings, and other parameters can be set for each staff and can change automatically during the performance, making orchestration simple.

The response to dynamics and other expressive indications can create remarkably subtle performances. A collection of sample scores ranging from Wagner's "Ride of the Valkyries" to a MIDI jazz composition demonstrates the depth of expression available.

As you listen to your synthesizers play your music, the screen turns pages, following

the performance. The tempo can be sped up or slowed down while you listen, or you can listen to the piece one event at a time—an invaluable tool for error checking. Switching between editing and playing modes is fast, so you can hear your changes quickly.

If support were added for laser printing with Adobe's Sonata or another font, this program would be hard to beat. Another helpful addition would be support for the new MIDI Files specification, allowing scores to be transferred to and from commercial music-sequencing programs.

But these are minor objections. MusicPrinter Plus combines one of the most powerful and easy-to-use music notation interfaces with surprisingly expressive MIDI performances, all at a very reasonable price.

List Price: *MusicPrinter Plus*, Version 2.0, $395. **Requires:** 640K RAM, graphics adapter, sizable printer (Epson 9-pin, Epson LQ 1500 24-pin, or compatible; Star Micronics SG-10 or SG-15; or Canon BJ-130), DOS 2.0 or later. Copy protected: Temporal Acuity Products Inc., Building 1, #200, 300 120th Ave. NE, Bellevue, WA 98005; (206) 462-1007.